PERIODICAL
3, no. 4 Meddel. Serie: Fisk.
Denmark. Dan. Fisk. Havs.
3(4

LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS

MEDDELELSER

FRA

KOMMISSIONEN FOR HAVUNDERSØGELSER

SERIE: FISKERI · BIND III

Nr. 4. A. C. Johansen: CONTRIBUTIONS TO THE BIOLOGY OF THE PLAICE WITH SPECIAL REGARD TO THE DANISH PLAICE-FISHERY. III. ON THE VARIATION IN FREQUENCY OF YOUNG PLAICE IN DANISH WATERS IN 1902—1907. (WITH 12 FIGURES IN THE TEXT)

KØBENHAVN
I KOMMISSION HOS C. A. REITZEL
BIANCO LUNOS BOGTRYKKERI
1908

MEDDELELSER FRA KOMMISSIONEN FOR HAVUNDERSØGELSER
SERIE: FISKERI · BIND III · NR. 4 · 1908

CONTRIBUTIONS

TO

THE BIOLOGY OF THE PLAICE

WITH SPECIAL REGARD TO THE DANISH PLAICE-FISHERY

III

ON THE VARIATION IN FREQUENCY OF YOUNG PLAICE IN DANISH WATERS IN 1902—1907

(WITH 12 FIGURES IN THE TEXT)

BY

A. C. JOHANSEN

KØBENHAVN
I KOMMISSION HOS C. A. REITZEL
BIANCO LUNOS BOGTRYKKERI
1908

I. Introduction.

1. Introductory remarks.

During the investigations concerning the frequency of young plaice in Danish waters, which have been carried on in the years 1902—1907, it has become evident that the young plaice are not present with approximately the same frequency in the same areas in different years. In certain waters the fry may in some years be present in multitudes, while it is very scarce in other years, and at the same time as the fry is relatively scarce in one area, it may occur with a comparatively great frequency in another area.

The variation in the frequency of the young plaice in the different years within certain areas of the sea evidently deserves an increasing degree of attention. This is a matter which not only invites to a closer study of the connection between hydrographical and biological phenomena, but which also regards questions of a purely practical nature, such as the transplantation and protection of young plaice. Investigations of a similar nature to those which will be mentioned here, but comprising other species, have been undertaken of later years from the Norwegian side by Dahl[1] and Hjort[2].

2. Method of the investigations.

The Danish quantitative investigations on the frequency of young plaice have mainly comprised the bottom stages. We have employed fishing apparatus of the same kind in several different years and have made use of certain fishing units: it is the use of a certain apparatus in a certain time or moved over a certain distance. We have partly compared the capture per fishing unit of a certain age-group in the different years at the same season and partly the frequency of the individuals of each of the different age-groups in the same year. That considerable difficulties arise when carrying out investigations in the latter direction must not be overlooked. In the first case it must be remembered that the various annual series of plaice have not all the same distribution. The individuals of the 0-Gr. live thus on an average in shallower water than the individuals of the I-Gr. and these again in shallower water than those of the II-Gr. Secondly, each apparatus undertakes a certain sorting of the present stock, as certain size groups are selected in preference to others. Moreover, it must not be forgotten that the younger annual series must normally be richer of individuals than the older ones. The younger the plaice the more exposed they are to attacks from enemies.

The younger series are naturally least influenced by the practical fishing. On which size groups the fishing especially is based depends essentially upon the rate of growth of the plaice. In certain areas the II-Gr. is not a little influenced by the fishing, in other areas the specimens of the II-Gr. are almost all undersized fish. The III-Gr. is highly affected in most of our waters.

[1] Knut Dahl: „Undersøgelser over Nytten af torskeudklækning i Østlandske fjorde." Aarsberetning vedk. Norges Fiskerier for 1906. — 1ste Hefte. Bergen 1906.

[2] Johan Hjort: „Nogle Resultater af den internationale Havforskning." Aarsberetning vedk. Norges Fiskerier for 1907. — 2det Hefte. Bergen 1907.

The quantitatve investigations, which shall be mentioned here, comprise in the main specimens which are too small to be taken to the market. If any great importance is to be attributed to such investigations based on fishing experiments, it is necessary to undertake them on a large scale. The frequency of individuals may vary greatly within small areas, and until a series of observations point in the same direction, we should not attach any great importance to the results.

Dr. REIBISCH's discovery of annual rings in the otoliths of plaice has to a high degree facilitated the investigations on the relative frequency of the various age-groups. If a relatively greater or smaller quantity of fry is hatched in a certain area, it may not only be traced in the year in question, but both in the next and following years and perhaps still longer. In our Danish investigations Dr. PETERSEN's method of measurement was usually adopted for the determination of the age of plaice till the spring of 1905. By this method, we are generally able to separate the 0-Gr., and the I-Gr. in spring, from the older series. A few otolith investigations were undertaken in 1904 and in the spring of 1905, but the otoliths were not usually employed for the age determinations till the summer of 1905. From this period, all the age determinations of plaice caught by otter-trawl and Young fish trawl, which will be mentioned here, rest on otolith investigations. Concerning the coast stations where specimens of the 0- and I-Gr. solely or mainly were captured, the otoliths of all the captured specimens were as a rule not examined, as this has not been necessary in order to obtain a reliable determination of age. For the younger series the frequency curves still render good service in the determination of age.

3. On the apparatus employed in the fishing for plaice.

Though apparatus of the same kind have been employed for a series of years, some variation has taken place with regard to their size. The new apparatus of the same kind have not always been of exactly the same size from the beginning, and most of the apparatus contract during use. A general view over the employed apparatus and their dimensions is given below:

A. To be used from the "Thor".

1) "50 feet otter-trawl". The length of the head line has varied from ca. 50—45 feet, the length of foot rope from 70—68 feet. At times an iron-chain of 30 kg. weight has been attached to the foot rope. Otter boards = 4 feet 10 inch. × 2 feet 5 inch.

The width of meshes has been as follows.

Square	ca. 55—60	mm.	(length of one side)
Top wings	- 55—60	—	—
Lower wings	- 60—65	—	—
Belly and baitings	- 40	—	—
Cod-end (below)	- 30	—	—
Extra cod-end	- 5—15	—	—

This apparatus has been employed at all depths in our seas from ca. 5 meters and above. It is well adapted for the capture of all series of plaice from ca. 15 cm. and upwards. The younger plaice of a length of 4—14 cm. are also partly captured by the otter-trawl, in preference in the finemeshed extra cod-end, but not in such numbers that they get a suitable representation in the capture in proportion to the older series. When this apparatus has been employed for the capture of plaice, the speed has been ca. 2·5 miles per hour.

2) Dr. PETERSEN's Young fish trawl of stramin. Dimensions:

Otter boards:	1·22 × 0·72	meters
Width in front	2 — 2·5	—
Height in front	c. 1·3	—
Total length	6 — 8	—
Size of meshes	1·5 — 2	mm. (one side).

This apparatus has been employed at all different depths from ca. 5 meters and above. It is especially adapted for the capture of the pelagic stages and the young bottom stages, but not suitable for abundant capture of the older series (speed ca. 1·5—2 miles per hour).

3) Young fish trawl of stramin with wings. Same apparatus as the preceding one provided with wings of ca. 5 meters length each.

B. To be used from a small motor boat.

1) Young plaice trawl. Dimensions:

Otter boards: 80 cm. × 37 cm. Foot rope: 5 m. Head line: 4·7 m. Total length: 7 m.
Size of meshes in wings and belly 1 cm. (one side of meshes).
— - — - cod-end 0·7 — —

A somewhat larger gear was employed from April—August 1907:

Foot rope: 7 m. Head line: 6 m. Total length: 9 m.

The young plaice trawl has only been employed in calm weather at the coasts, as a rule at depths between 1 and 5 meters. The apparatus cannot be employed on stony ground. There must be at least some sand spots between the stones to give room for work with the trawl. The apparatus is especially fit for the capture of the older stages of the 0-Gr. and the younger stages of the I-Gr.

2) 11 feet beam-trawl provided with small meshed cod-end.

C. To be used on shore.

1) Eel seine. Total length 47 m., used as ground seine.

2) Hand shove net. (Stramin or small meshed net.) Span in front ca. 60—70 cm.

4. On the limitation of the different waters.

Concerning the limits between our different waters, I shall refer to one of my previous papers "Contributions to the Biology of the Plaice II"[1] p. 4 and 5. Only a few supplementary remarks will be added here:

The northern limit of the Belt Sea is formed by the line Gniben-Hasenøre, the eastern limit by the submarine ridge between Gedser and Darsserort. The "Western Baltic" should here be understood as the southern part of the Belt Sea or the water south of the Danish Islands. The "Belts" means here the Belt Sea minus the Western Baltic.

The limit between the northern Kattegat and the middle Kattegat is here drawn at the 57°N. Lat.

II. General view over the distribution of the younger series of plaice in Danish Waters.

Off the west coast of Jutland in the North Sea and the Skagerak, the bottom stages of the 0 Gr[2] are present mainly in quite a narrow shore belt from 0 to ca. 5 meters depth, but odd specimens may however already in spring, April—June, be found in somewhat deeper water.

With regard to the frequency of the 0-Gr. at the different localities, it appears here as elsewhere, that great variations take place from one year to another. It is, however, a rule, that specimens of the

[1] Meddelelser fra Kommissionen for Havundersøgelser, Serie Fiskeri. Bd. II No. 5. 1907.

[2] The 0-Gr. are fishes under one year old, the I-Gr. fishes between one and two years old, and so on. A plaice's year is assumed to commence on April 1st.

0-Gr. are present in abundance in the inshore waters at Thyborøn and Esbjerg. It is evidently also a general feature that an abundance of fry occurs between the sand ridges in certain places off the open coasts, e. g. in Tannis Bay and in the Horns Reef area, while the sand banks forming the very Horns Reef seem to be almost devoid of fry.

The I-Gr. has its main distribution at depths between 0—20 meters. In the inshore waters at Esbjerg and Thyborøn this group occurs frequently together with specimens of the II-Gr., the III-Gr., and the IV-Gr. At the open coasts the II-Gr. removes as a rule from the area where the 0-Gr. is mainly distributed, and in the course of the summer it spreads quite down to the 40 meter line or still further out. It is first later on that the plaice takes possession of the entire area which indicates the distribution of the species. The bulk of the specimens both of the III-Gr. and IV-Gr. occur even in summer at depths below 40 meters.

In the Kattegat and in the Belts the 0-Gr. of the plaice occurs in the main in quite shallow water from the beach to a depth of 2—5 meters. From June or July to the end of March the 0-Gr. occurs as a rule far more frequently than the older series at depths of less than two meters. When we employ finemeshed apparatus, it is unusual at this depth to catch more specimens of the I-Gr. than of the 0-Gr. To this Aalbœk Bay and Tannis Bay form exceptions, at any rate in certain years, for the reason that a considerable immigration of young plaice takes place from the Skagerak to Aalbœk Bay and probably from Jammer Bay to Tannis Bay.

Many more specimens of the I-Gr. than of the 0-Gr. go down to a depth of 5—10—20 meters. To state as a general rule at what depth the population of the I-Gr. is thickest, cannot be done. It varies according to the nature of the localities as well as the season.

The same holds good for the I-Gr. as for the 0-Gr. that, gradually as the specimens increase in age and size, they move out into deeper water. As a general rule it may, however, be said, also with regard to the I-Gr. in the Kattegat and in the Belts, that it has its main distribution at depths between 0 and 20 meters.

Of the II-Gr. we may still in early summer find several specimens in shallow water from 0—2—5 meters' depth, while the bulk of the specimens in the course of the summer remove somewhat from the coasts, so that only a few specimens of the II-Gr. are caught in the autumn in the area where the 0-Gr. mainly has its distribution.

In the Western Baltic and in the Sound the 0-Gr. of the plaice occurs also mainly in quite shallow water near to the coasts. The young plaice here seem to show an inclination to disappear from the coast earlier than in the before mentioned waters.

In the true Baltic the conditions are quite different from those in the waters mentioned before, as the 0-Gr. of the plaice in the Baltic has its normal distribution in deeper water, from ca. 10 — ca. 40 meters depth. Thus the 0-Gr. occurs here together with the I-Gr. the II-Gr., the III-Gr., and so on.

The evidence of the observations which have been set forth here, may be looked for in Table 1 and in sections III. IV. and V. with the accompanying charts. The stock of plaice in the true Baltic will be treated more in detail in a later paper.

Table 1. Synoptic Table showing capture of Plaice of the various age-groups in Danish waters in 1905—1907.

A. Coast investigations by Young Plaice trawl.

Station No.	Date	Place	Central Position N	Central Position E	Depth m.	Temperature & Salinity, surf. °C.	Temperature & Salinity, surf. ‰	Duration of fishing hours	Pleuronectes platessa 0 gr.	I gr.	II gr.	III gr.	IV gr.	V+ gr.	? gr.	total No.
		The North Sea.														
477	1905 June 26	Off Thorsminde.	56°21′,7	8°06′,3	2—4	..	..	1/2	9	..	..	..	..	..	..	9
478	» » 26	1/2 mile NW of Thorsminde.	56°22′,2	8°06′,3	4—6	..	..	1/2	11	1	..	..	..	..	..	12
488	» » 30	S of Thorsminde and 1 mile to the south.	56°20′,9	8°06′,3	2—5	..	..	2/3	12	..	..	..	..	..	..	12
489	» » 30	From Thorsminde 1 1/2 miles to the north.	56°23′,3	8°06′,6	2—5	..	..	2/3	5	1	..	..	..	..	..	6
490	» » 30	2 1/2 miles N by W of Thorsminde.	56°24′,1	8°06′,6	2—5	..	..	1/2	4	..	..	..	..	..	..	4
493	» July 3	Thyborøn canal.	56°42′,8	8°14′,0	2—4	18	33	1	1	15	..	..	..	..	3	19
494 B	» » 4	From Thyborøn canal 1 mile to S by E.	56°41′,7	8°13′,6	2—4	..	..	1	5	5	..	..	..	..	..	10
498	» » 5	1 1/2 miles E of Thyborøn canal.	56°42′,0	8°16′,4	1—4	19	32	1	70	10	..	..	..	..	3	83
502	» » 6	2 miles SE by S of Thyborøn canal.	56°40′,9	8°16′,6	1—3	..	..	5/6	206	24	..	..	..	..	9	239
508	» » 10	Nissum Bredning, 3 miles ESE of Thyborøn.	56°41′,4	8°18′,4	1—4	..	..	5/12	38	23	..	..	..	..	13	74
511	» » 11	2 miles E by S of Thyborøn.	56°42′,0	8°16′,5	1—4	..	..	1/2	6	29	..	..	..	..	5	40
513	» » 12	Off the beach 3/4 miles ESE of Thyborøn.	56°41′,7	8°14′,7	2—4	..	..	1 1/4	33	32	18	..	..	..	3	86
514	» » 13	Entrance of Thyborøn canal.	56°43′,0	8°13′,0	1—4	15°8	31	3/4	37	32	..	..	..	..	12	81
516	» » 14	1—2 miles S of Thyborøn canal, in the fjord.	56°40′,7	8°13′,9	2—4	17	32·5	1 1/4	120	..	..	..	..	..	171	291
520 B	» » 18	Thyborøn canal.	56°42′,6	8°14′,8	2—4	16°2	31	1/3	13	3	6	..	..	..	2	24
522	» » 19	1—2 miles S of Thyborøn canal, in the fjord.	56°40′,1	8°14′,0	2—4	..	..	1	21	8	..	..	..	..	..	29
523	» » 19	From Thyborøn canal 1 mile to the south.	56°41′,2	8°14′,0	1—3	17	31	1	286	77	26	..	..	..	6	395
526	» » 21	Thyborøn canal.	56°42′,7	8°14′,2	1—4	..	..	1/3	20	9	..	..	..	..	..	29
527	» » 21	1 mile N of Røn Land, in the fjord.	56°40′,6	8°13′,3	1—2	..	..	1	27	..	..	..	..	..	65	92
528	» » 22	Thyborøn canal.	56°42′,7	8°14′,2	2—5	..	..	1	6	7	..	..	..	..	2	15
529	» » 24	2 miles N of Lodbjerg Light.	56°51′,2	8°15′,6	4—5	..	..	1/3	23	..	..	..	..	..	..	23
530	» » 24	1 mile S of Lyngby, danger-signal station.	56°51′,6	8°16′,1	4	17	31·5	1/4	9	..	..	..	..	..	..	9
533	» August 4	1/2 mile WSW of Lyngby — —	56°52′,3	8°16′,6	4—6	..	..	1/4	..	..	..	..	..	..	5	5
534	» » 4	1 mile N of Lyngby — —	56°53′,4	8°17′,6	3—4	16	31	2/3	15	14	..	..	..	..	2	31
535	» » 8	2 1/2 miles N of Lyngby — —	56°54′,8	8°19′,0	3—5	..	..	1/3	16	1	..	..	..	..	1	18
536	» » 8	3/4 miles S of Stenbjerg — —	56°55′,3	8°19′,4	4	..	..	1/3	9	..	..	..	..	..	..	9
538	» » 8	3 miles N of Vorupør.	56°59′,7	8°24′,6	3	..	..	1/3	14	8	..	..	..	..	..	22
539	» » 8	3 miles S of Klitmøller.	57°00′,7	8°26′,0	3	17	31	1/3	54	13	..	..	..	..	..	67
540	» » 9	Off Klitmøller.	57°03′,0	8°29′,4	2—4	..	..	1/3	73	21	..	..	..	..	..	94
544	» » 14	1 1/2 miles S of Hanstholm Light.	57°06′,3	8°34′,0	4—7	..	..	2/3	13	..	..	..	..	..	..	13
573	» Sept. 21	Off Thyborøn beacon to the south.	56°41′	8°10′	4—8	..	..	1	4	..	.	..	..	..	..	4
574	» » 21	Off Knoppen, NW of Harboøre.	56°38′	8°09′	4—6	..	..	1 1/2	12	2	..	..	..	..	..	14
575	» » 21	Off Harboøre.	56°37′	8°09′	4—5	.	..	1/2	8	4	..	..	..	..	..	12
578	» » 22	S of Vedersø beacon.	56°14′	8°07′	4—6	..	..	2	22	..	..	..	..	..	..	22
579	» » 22	Off Husby Klit.	56°10′	8°07′	2—3	..	..	3/4	7	1	..	..	..	..	..	8
580	» » 22	1 mile N of Aargab beacon.	56°00′	8°07′	3—5	..	..	1/2	29	1	..	..	..	..	..	30
581	» » 22	Betw. Aargab beacon and Aargab signal-mast.	55°58′	8°08′	2—3	..	..	1 1/2	107	1	..	..	..	..	..	108
582	» » 22	1/2 mile S of Aargab signal-mast.	55°57′	8°08′	2	..	..	1/2	1	..	..	..	..	..	..	1
584	» » 23	1 1/2 miles N of Kærgaarde beacon.	55°43′	8°09′	1—3	..	.	2	28	14	..	..	..	..	..	42
585	» » 23	Off Kærgaarde.	55°42′	8°09′	1—3	..	..	1	8	2	..	..	..	..	..	10
586	» » 23	2 miles S of Kærgaarde beacon.	55°40′	8°08′	1—2	..	..	1	13	15	..	..	..	..	..	28
588	» » 25	4 miles W of Skallingen.	55°30′	8°14′	1—3	..	..	1 1/2	248	27	4	..	..	..	..	279
589	» » 25	3 miles SE of Blaavands Point.	55°32′	8°09′	1—2	..	..	3/4	211	18	3	..	..	..	..	232
590	» » 25	1 1/2 mile SE of Blaavands Point.	55°32′,5	8°07′	1	..	..	3/4	128	16	1	..	..	..	..	145
596	» » 28	Westside of Fanø, 2 miles N af Sønderho.	55°21′	8°25′	1	..	..	1	82	1	..	..	..	..	..	83
597	» » 28	Westside of Fanø, between the marine hotel and Sønderho.	55°24′	8°23′	1—2	..	..	1	119	4	..	..	..	..	..	123
598	» » 28	Westside of Fanø from the marine hotel to the north.	55°26′	8°21′	1—3	..	..	1/3	62	9	..	..	..	..	..	71
599	» » 29	SE of Esbjerg, off Maade brick-manufactory.	55°27′	8°28′	3—5	..	..	1	18	54	2	..	1	..	..	75
602	» Octbr. 2	Between Esbjerg harbour and Sandodden.	55°28′	8°25′	1—8	..	..	1 1/2	33	c. 52	c. 42	..	..	..	3	130
603	» » 2	Between Sædenstrand Light and Sandodden.	55°29′	8°24′	1—9	..	..	1 1/2	21	c. 42	c. 9	..	..	..	2	74
966	1907 April 20	Between Esbjerg harbour and Ringeby.	55°27′	8°28′	2—5	6°2	25·6	1	..	7	13	4	..	..	1	25
967	» » 20	Off Ringeby, Fanø.	55°27′	8°27′	1—4	5°8	26·6	3/4	..	59	77	26	1	..	5	168

Table 1. Continued.

Station No.	Date	Place	Central Position N	Central Position E	Depth m.	Temperature & Salinity, surf. °C.	Temperature & Salinity, surf. ‰	Duration of fishing hours	Pleuronectes platessa 0 gr.	I gr.	II gr.	III gr.	IV gr.	V+ gr.	? gr.	total No.
968	1907 April 22	SW of Hjerting.	55°30′	8°21′	2—4	..	..	2	..	55	71	53	6	..	9	194
969	» » 22	NW of Hjerting.	55°32′	8°20′	2—4	..	..	1	..	17	63	16	2	..	..	98
971	» » 24	S of Maade brick-manufactury, Esbjerg.	55°27′	8°30′	2	..	..	2	..	116	63	20	6	1	4	210
972	» » 24	Off Maade brick-manufactury, Esbjerg.	55°27′	8°29′	2—3	..	..	2	..	48	457	100	15	..	20	640
		The Skagerak.														
549	1905 August 18	Sandnæs Hage.	57°09′,9	8°58′,5	2	..	..	1/4	42	1	..	..	..	..	..	43
550	» » 18	W of Bulbjerg.	57°09′,9	9°01′,0	2	16°5	31·5	1/4	38	5	..	..	..	..	..	43
552	» » 21	W of Bulbjerg.	57°09′,9	9°01′,0	3	..	..	1/3	44	18	1	..	..	..	..	63
554	» » 23	1 mile W of Madsbøl life-boat station.	57°07′,0	8°50′,5	3	..	..	1/2	24	15	..	..	..	..	1	40
555	» Sept. 5	From Sandnæshage to Bulbjerg.	57°09′,7	9°00′,0	2—4	..	..	1/2	14	16	..	..	..	..	1	31
556	» » 6	1/2—1 mile E of Bulbjerg.	57°09′,6	9°03′,1	1—3	14°5	32	1/2	7	7	..	..	..	..	..	14
557	» » 6	1 1/2—2 1/2 miles E of Bulbjerg.	57°08′,8	9°05′,5	1—3	..	..	1	189	90	..	..	..	..	..	279
558	» » 6	3—3 1/2 miles E of Bulbjerg.	57°09′,0	9°08′,0	2—4	..	..	1/2	44	28	..	..	..	..	..	72
560	» » 13	From Thorupstrand 1 mile to the east.	57°08′,5	9°09′,5	2—4	..	..	1/2	132	26	..	..	..	..	2	160
561	» » 13	1 mile E of Thorupstrand to the east.	57°08′,7	9°10′,7	2—4	14	32	5/6	127	56	..	..	..	..	2	185
562	» » 13	1 mile W of Thorupstrand.	57°08′,9	9°06′,4	2—4	..	..	3/4	99	24	..	..	..	..	..	123
570	» » 20	1 mile W of Blokhuse.	57°15′	9°34′	4	..	..	2/3	12	12	..	..	..	..	..	24
571	» » 20	Off Rødehuse.	57°13′	9°31′	1—3	..	..	1	454	30	..	..	..	..	..	484
572	» » 20	1 mile W of Rødehuse.	57°12′	9°29′	4—6	13°5	32·4	1	87	32	..	..	..	..	..	119
623	» Octbr. 12	2 miles E of Hirshals.	57°36′	10°00′	1—2	..	..	1/2	28	66	..	..	..	..	..	94
624	» » 12	4 miles E of Hirshals.	57°35′	10°04′	1—2	..	..	1/2	37	191	7	1	..	..	..	236
625	» » 12	2 miles W of Tversted beacon.	57°36′	10°07′	1	..	..	1/2	92	193	3	..	..	..	..	288
642	» » 21	1 mile NE of Spirbakken beacon.	57°42′	10°28′	1—3	..	..	1	20	37	..	..	..	..	..	57
643	» » 21	c. 1 mile SW of Spirbakken beacon.	57°41′	10°25′	1—3	..	..	1	20	93	..	..	..	..	..	113
662	» » 31	Close N of Løkken.	57°22′	9°42′	1—3	..	..	1	66	9	..	..	..	..	..	75
663	» » 31	S of Lyngby church.	57°25′	9°44′	2	..	..	1	138	11	4	..	..	..	..	153
664	» » 31	Close N of Lyngby church.	97°26′	9°44′	c. 2	..	..	1/2	82	..	..	..	..	..	..	82
818	1906 » 5	2 miles E of Hirshals.	57°36′	10°00′	1—2	..	..	1	59	63	8	..	..	..	..	130
819	» » 5	4 miles E of Hirshals.	57°35′	10°04′	1—2	..	..	1	124	83	10	..	..	..	1	218
820	» » 5	2 miles W of Tverstsd beacon.	57°35′	10°07′	1	..	..	1	23	161	10	..	..	..	..	194
822	» » 5	1 mile SW of Spirbakken beacon.	57°41′	10°25′	1—3	..	..	1	10	68	9	..	..	..	2	89
823	» » 5	1 mile NE of Spirbakken beacon.	57°42′,5	10°28′	1—3	..	..	1	8	17	..	..	..	..	2	27
1038	1907 May 15	Off Kandestederne.	57°39′	10°22′	2—3	11°0	31·2	1/2	1	..	3	..	..	..	..	4[1]
1086	» June 1	Off Blokhusene beacon.	57°15′	9°33′	2—3	..	..	1	1	11	..	..	..	..	..	12
1087	» » 1	Off Blokhusene beacon.	57°15′	9°33′	4—5	..	..	1	..	90	..	..	..	..	..	90
		The Kattegat and Sound.														
609	1905 Octbr. 9	1 mile S of Elsinore harbour.	56°01′	12°37′	2	..	..	1/2	1	..	..	..	..	..	..	1
610	» » 9	4 miles S of Elsinore harbour.	55°59′	12°34′	2—3	..	..	1/2	4	..	..	..	..	..	..	4
611	» » 9	N of Elsinore.	56°03′	12°36′	1—2	..	..	1/2	22	1	..	..	..	..	..	23
612	» » 9	2 miles N of Kronborg.	56°04′	12°35′	1—2	..	..	1/2	9	..	..	..	..	..	..	9
614	» » 10	Off Nakkehoved.	56°06′	12°24′	1—3	..	..	2/3	3	..	..	..	..	..	..	3
615	» » 10	From Gilleleje harbour to the east.	56°07′	12°20′	c. 3	..	..	1/3	2	..	..	..	..	..	..	2
626	» » 13	Close S of Skagen harbour.	57°43′	10°36′	1—3	..	..	1	16	40	..	..	..	..	..	56
627	» » 13	2 miles SW of Skagen harbour.	57°41′	10°32′	1—3	..	..	1	7	31	..	..	..	..	..	38
628	» » 13	1 mile NE of Hulsig.	57°39′	10°30′	1—3	..	..	1	4	1	..	..	..	..	..	5[1]
631	» » 14	2 miles S of Aalbæk.	57°33′	10°27′	1—2·5	..	..	1	15	80	..	..	..	..	..	95
632	» » 14	Fr. Aalbæk life boat station 1/4 m. to the north.	57°36′	10°26′	1—2	..	..	1	13	81	..	..	..	..	..	94
633	» » 14	Off Hulsig church, Aalbæk Bay.	57°39′	10°29′	1—2·5	..	..	1/2	..	19	..	..	..	..	..	19
635	» » 19	S of NW Reef, Læsø.	57°16′	10°50′	1—2	..	..	1	..	..	..	..	..	..	..	0
636	» » 19	2 miles S of the NW Reef, Læsø.	57°14′	10°53′	1—1·5	..	..	1	6	1	..	..	..	..	..	7
637	» » 19	4 miles S of the NW Reef, Læsø.	57°13′	10°54′	1—1·5	..	..	1	2	1	..	..	..	..	..	3
638	» » 19	6 miles S of the NW Reef, Læsø.	57°11′	10°54′	1—2·5	..	..	1	2	..	..	..	..	..	..	2
640	» » 20	Close S of Skagen harbour.	57°43′	10°37′	1—2	7°8	28·7	1	4	18	..	..	..	..	..	22
641	» » 20	N of Skagen harbour.	57°44′	10°38′	1—2	7°8	28·7	1	2	6	..	..	..	..	..	8
645	» » 24	Close S of Frederikshavn harbour.	57°26′	10°33′	1—2	..	..	2	42	25	..	..	..	..	..	67

[1]) Failed haul.

Table 1. Continued.

Station No.	Date	Place	Central Position N	Central Position E	Depth m.	Temperature & Salinity, surf. °C.	Temperature & Salinity, surf. ‰	Duration of fishing hours	Pleuronectes platessa 0 gr.	I gr.	II gr.	III gr.	IV gr.	V+ gr.	? gr.	total No.
646	1905 Octbr. 24	Between Frederikshavn and Sæby.	57°23′	10°32′	1—3	..	..	½	3	1	..	..	..	..	..	4
648	» » 26	1 mile S of Strandby.	57°29′	10°31′	0·5—1	..	..	1	2	4	..	..	..	..	..	6
649	» » 26	N of Frederikshavn. Off Hirsholmene.	57°28′	10°33′	1—2	..	..	1	2	45	..	..	..	..	..	47
650	» » 26	S of Stensnæs Flak.	57°12′	10°30′	1—2	4°9	23·6	1	6	2	..	..	..	..	..	8
651	» » 26	½ mile N of Asaa harbour.	57°10′	10°27′	1—5	..	..	1	3	..	..	..	..	..	..	3
655	» » 27	Close N of Als church.	56°46′	10°18′,7	1—3	..	..	½	1	..	..	..	..	..	..	1
656	» » 27	S of Egense Light, entrance to Hals.	56°57′,5	10°20′,2	0·5—2	..	..	1½	4	..	..	..	..	..	..	4
657	» 28 & 29	Nordmanshagen, N of the entrance to Hals.	56°59′,5	10°21′,5	1—3	..	..	7	110	8	..	..	..	..	..	118
667	» Nov. 2	N of the sanatorium, Frederikshavn.	57°28′	10°33′	1—2	..	..	2	2	54	..	..	..	..	..	56
668	» » 4	Off Horner point, N of Læsø.	57°19′,1	11°01′,5	1—2·5	..	..	½	..	6	1	..	..	..	..	7
669	» » 4	Between Horner point and Rønner Reef.	57°18′	11°00′	1—2·5	..	..	1	2	11	..	..	..	..	..	13
670	» » 4	East side of Rønner Reef, N of Læsø.	57°19′	10°58′	1—3	..	..	1	4	11	..	..	..	..	..	15
672	» » 7	Close S of Frederikshavn harbour.	57°26′	10°33′	1—2	..	..	3	179	64	1	..	..	..	..	244
673	» » 7	Off Aalbæk.	57°35′	10°26′	1—3	..	..	2½	61	145	4	..	..	..	..	210
675	» » 8	E of Hevring Flak.	56°31′	10°30′	0·5—2	8°5	25·0	3	46	5	..	..	..	..	..	51
677	» » 9	N of Djursland, 1 mile W of Treaa mill.	56°32′	10°41′	0·5—1	7°7	20·3	1	45	1	..	..	..	..	..	46
678	» » 9	N of Djursland, off Treaa mill.	56°32′,4	10°42′,2	1·5—3	7°7	20.3	1	2	2	..	..	..	..	..	4
679	» » 9	N of Djursland, 1 mile E of Treaa mill.	56°32′	10°44′	0·5—2	7°7	20·3	½	4	..	..	..	..	..	..	4
680	» » 9	Southern side of Anholt, near the SW point.	56°41′	11°35′	0·5—2	7°8	28·7	1	..	1	..	..	..	..	..	1
681	» » 9	Southern side of Anholt.	56°43′	11°37′	1—2	7°8	28·7	1	..	2	..	..	..	..	..	2
682	» » 9	Southern side of Anholt, SW of the Light.	56°44′	11°40′	1—2	7°8	28·7	½	1	..	..	..	..	..	..	1
725	1906 March 6	Off Yderby, N of Sjællands Odde.	55°59′	11°21′	2—4	..	..	1	1	..	..	..	..	..	..	1
824	» Octbr. 8	From Sæby harbour 1 mile to the south.	57°19′,5	10°32′	1—3	..	..	½	..	..	..	..	..	..	..	0
826	» » 8	S of Frederikshavn. From Bangsbo Strand to the south.	57°25′	10°32′	1—2	12°2	..	¾	27	8	..	..	..	..	..	35
827	» » 8	S of Frederikshavn, from the mole to off Bangsbo Strand church	57°26′	10°32′,5	1—4	12°2	..	2	68	19	1	..	..	..	..	88
829	» » 10	West side of Læsø, NE of the harbour.	57°18′5	10°56′	1—3	11°5	..	1	6	6	..	..	..	..	..	12
830	» 10 & 11	West side of Læsø, SW of the harbour.	57°17′	10°54′	1—3	11°7	..	2½	14	50	..	..	..	..	..	64
831	» » 11	West side of Læsø, close by the NW Reef.	57°16′	10°50′	1—3	..	..	1	4	..	..	..	..	..	..	4
834	» » 13	Aalbæk Bay, 1 mile S of Strandby.	57°29′	10°31′,5	1	11°4	..	1	25	14	2	..	..	..	1	42
835	» » 13	2 miles S of Aalbæk.	57°34′	10°26′,5	1—2·5	11°9	..	1	23	16	1	..	..	..	..	40
836	» » 13	Off Aalbæk.	57°35′	10°26′	1—3	12°2	..	1½	40	51	6	..	..	..	..	97
837	» » 13	Off Hulsig church.	57°39′	10°29′	1—2·5	12°2	..	1	7	22	2	..	..	..	..	31
838	» » 13	2 miles SW of Skagen harbour.	57°41′	10°32′	1—3	11°6	..	1	33	11	2	..	..	..	..	46
841	» » 15	S of Frederikshavn harbour.	57°26′	10°33′	1—4	10°4	..	6½	42	52	6	..	..	..	2	102
842	» » 16	S of Frederikshavn harbour.	57°26′	10°33′	1—2·5	..	..	2½	130	34	5	..	..	..	..	169
846	» » 18	S of Frederikshavn harbour.	57°26′	10°33′	2—5	..	..	2½	110	22	2	..	..	..	..	134
848	» 19 & 20	N of the entrance to Hals.	56°59′	10°21′	1—3	10°2	..	9	178	16	..	..	..	..	..	194
849	» » 20	S of the entrance to Hals.	56°57′	10°20′	1—2·5	10°8	..	1	4	1	..	..	..	..	..	5
850	» » 21	Off Aalbæk to the south.	57°35′	10°26′	1—3	..	..	5	215	377	12	..	..	..	..	604
853	» » 22	N of Skagen harbour.	57°44′	10°38′	1—3	..	..	4	42	65	2	..	..	..	..	109
854	» » 22	Glose S of Skagen harbour.	57°43′	10°36′	1—3	..	..	3	28	74	1	..	..	..	..	103
861	» » 25	N of Djursland, c. 1 mile E of Treaa mill.	56°32′	10°44′	1—2	9°0	..	1	23	7	..	..	..	..	..	30
862	» » 25	N of Djursland, 1 mile W of Treaa mill.	56°32′	10°40′	1—2	9°0	..	1	22	4	..	..	..	..	..	26
863	» » 25	N of Djursland, 1 mile E of Fjellerup.	56°31′	10°37′	1—2	9°2	..	1½	26	14	..	..	..	..	..	40
867	» » 26	N of Djursland, W of Fjellerup.	56°31′	10°34′	1—2	..	..	1	30	4	..	..	..	..	..	34
868	» » 26	N of Djursland, 1½ miles W of Treaa mill.	56°32′	10°39′	1—2	..	..	3	35	12	..	..	..	..	..	47
869	» » 26	N of Djursland, 1½ miles E of Treaa mill.	56°32′	10°45′	1—2	..	..	1	7	2	..	..	..	..	..	9
873	» » 28	Off Tisvildeleje.	56°04′	12°04′	1—2·5	9°0	..	¾	7	..	..	..	..	..	..	7
874	» » 28	Off the western border of Tisvilde plantation.	56°03′	12°03′	1—3	9°0	..	3	32	..	..	..	..	..	..	32
875	» » 29	Off Liseleje (North Sealand).	56°01′	11°58′	1—2·5	7°8	..	2	44	..	..	..	..	..	..	44
876	» » 29	1 mile E of Liseleje.	56°01′	11°59′	1—1·5	7°8	..	2	54	..	..	..	..	..	..	54
877	» » 29	2 miles E of Liseleje.	56°02′	12°01′	1—1·5	..	..	2	25	..	..	..	..	..	..	25
879	» » 30	From Kronborg point to the north-west.	56°03′	12°37′	1—2	9°0	..	3	128	4	..	..	..	..	..	132
880	» » 30	Off Marienlyst at Elsinore.	56°03′	12°36′	1—2	8°8	..	1	34	1	..	..	..	..	..	35
1044	1907 May 18	SW of Skagen harbour.	57°43′	10°34′	1·5-2·5	..	..	½	..	18	2	..	..	..	..	20

Table 1. Continued.

Station No.	Date	Place	Central Position N	Central Position E	Depth m.	Temperature & Salinity, surf. °C.	‰	Duration of fishing hours	Pleuronectes platessa 0 gr.	1 gr.	II gr.	III gr.	IV gr.	V+ gr.	? gr.	total No.
1045	1907 May 18	Close S of Skagen harbour.	57°43′	10°35′	4—5	..	..	1/2	..	4	..	..	..	..	..	4
1059	» » 23	Off Aalbæk.	57°36′	10°27′	1—2	11°5	21·0	1	2	220	26	..	..	..	..	248
1060	» » 23	Off Aalbæk.	57°36′	10°27′	2—4	10°	20·7	1	3	75	23	1	..	1	..	103
1063	» » 24	N of the entrance to Hals.	56°59′	10°22′	1—2	11°5	22·3	2	3	51	2	..	..	..	..	56
1064	» » 24	N of the entrance to Hals.	56°59′	10°22′	2—4	10°5	22·1	1	..	18	1	..	..	..	..	19
1096	» June 4	Between Skagen and Hulsig.	57°41′,5	10°33′	2—4	..	..	1	..	31	11	..	..	..	1	43
1097	» » 4	Between Skagen and Hulsig.	57°41′	10°32′	4—5	..	..	1	..	12	7	..	..	..	1	20
1098	» » 4	Off Aalbæk.	57°36′	10°27′	2—4	12°5	18·8	1	3	44	17	..	..	..	..	64
1104	» » 6	Off Vesterø church, Læsø.	57°17′	10°54′	c. 3	11°0	18·3	1	..	2	..	..	..	..	..	2
1105	» » 6	SW of the harbour at Vesterø, Læsø.	57°18′	10°55′	c. 3	..	..	1	1	10	2	..	..	.	..	13
1108	» » 7	Off Hevringholm, N of Djursland.	56°32′	10°26′	2	12°5	19·3	1	2	39	..	..	..	..	..	41
1109	» » 7	Off Hevringholm, N of Djursland.	56°32′	10°27′	3—4	12°5	18·8	1	..	1	..	..	..	..	..	1
1111	» » 7	Off Bønnerup Strand, N of Djursland.	56°32′	10°43′	2	11°5	21·0	1	..	13	8	..	..	..	..	21
1117	» » 8	Off Hellebæk. North Sealand.	56°04′	12°34′	2	12°0	12·0	1	..	11	..	..	..	..	..	11
1169	» August 10	Off Strandby. Aalbæk Bay.	57°30′	10°30′,5	1—3	..	..	1	9	24	2	..	..	..	..	35
1170	» » 10	Off Frydenstrand, Frederikshavn.	57°27′	10°34′	c. 1	..	..	1	89	174	16	1	..	..	..	280
1171	» » 10	S of Frederikshavn harbour.	57°25′,5	10°32′,5	2	..	..	1	27	5	2	..	..	..	..	34
1172	» » 10	Close S of Bangsbo.	57°24′,5	10°32′,5	2—3	..	..	1	8	..	..	..	..	..	..	8
1181	» » 14	1 mile NE of Aalbæk.	57°37′	10°26′	1—2	..	..	1/2	21	8	..	..	..	..	..	29
1182	» » 14	1 mile S by E of Aalbæk.	57°35′,5	10°26′	1—2	..	..	1/2	53	16	..	..	..	..	..	69
1183	» » 14	Off Jerup. Aalbæk Bay.	57°33′	10°27′	1—2	..	..	1/2	36	17	2	..	..	..	..	55
1184	» » 15	2 miles SSW of Asaa.	57°07′	10°25′	2	..	..	1	115	13	..	..	..	..	..	128
1185	» » 15	1 mile NE by E 1/2 E of Hou.	57°04′	10°23′,5	2	..	..	1	105	7	1	..	..	..	..	113
1187	» » 16	Off Hellebæk, North Sealand.	56°04′	12°34′	2—3	14°4	18·2	1	6	15	..	..	..	..	..	21
		The Belt Sea.														
684	1905 Nov. 10	Southern side of Sejrø, near the Light.	55°54′,7	11°04′,8	1—2	7°4	12·2	1	3	..	..	..	..	..	..	3
685	» » 10	Southern side of Sejrø, NW of the harbour.	55°53′	11°07′	1—2·5	7°4	12·2	1/3	1	..	..	..	..	..	..	1
686	» » 10	Western side of Samsø, 2 m. N of Kolby Kaas.	55°49′,4	10°31′,8	1—2·5	7°3	11·9	1	40	..	..	..	..	..	..	40
687	» » 10	Western side of Samsø, 3 m. N of Kolby Kaas.	55°50′,6	10°31′,9	1—3	..	..	1	13	.	..	.	..	..	..	13
689	» » 11	S of the harbour of Kerteminde.	55°26′,6	10°41′,0	1—2·5	..	..	1	6	..	..	..	..	..	..	6
690	» » 11	Off Kerteminde, N of the harbour, off the mill.	55°27′,2	10°40′,0	0·5-1·5	..	..	1 1/2	22	..	..	..	..	..	.	22
691	» » 12	2 miles S of Korsør harbour.	55°18′,2	11°10′,4	0·5—1	..	..	1	2	..	..	..	..	..	..	2
692	» » 12	1/2 mile S of Korsør harbour.	55°19′,2	11°08′,2	1—2	..	..	1	2	..	..	..	..	..	.	2
694	» » 13	N of Bagenkop harbour, Western side of Langeland.	54°45′,5	10°40′,5	1—2	7°3	10·8	1	..	..	..	..	..	..	.	0
695	» » 13	N of Bagenkop harbour.	54°46′,5	10°40′	4—5	..	..	1	..	..	..	..	..	.	..	0
696	» » 13	3 miles N of Bagenkop harbour.	54°48′	10°40′	1—2	..	..	1 1/2	..	..	..	..	..	..	..	0
698	» » 14	3 miles N of Bagenkop harbour.	54°48′	10°39′	4—6	7°0	11·0	1/2	..	..	..	..	..	..	1	1
699	» » 14	3 miles N of Bagenkop harbour.	54°48′	10°39′	1—2	7°0	11·0	1	2	..	..	..	..	..	..	2
701	» » 15	Southern side of Laaland, 2 miles SE by S of Kramnitze Gab.	54°40′,8	11°18′	1—2	5°9	8·1	1	1	..	..	..	..	..	.	1
702	» » 15	Southern side of Laaland, 3 miles SSE 1/4 E of Kramnitze Gab.	54°39′	11°19′	3—5	5°9	8·1	1	..	..	..	..	..	..	..	0
703	» » 15	Southern side of Laaland, 5 1/2 miles SE by S of Kramnitze Gab.	54°38′,7	11°22′	1—2	..	..	1	2	..	..	..	..	..	..	2
855	1906 Octbr. 23	Sælvig. Samsø.	55°52′	10°33′	1—2	..	..	1	7	4	..	..	..	..	..	11
856	» » 23	Sælvig, Samsø, 1/2 mile E of the pier.	55°52′	10°34′	1—1·5	..	..	1	30	13	..	..	..	..	.	43
857	» 23 & 24	Sælvig, Samsø, 1 mile E of the pier.	55°52′	10°35′	....	..	..	4	142	33	..	..	..	..	.	175
858	» » 24	Sælvig, Samsø, off Bisgaard.	55°53′	10°36′	0·5-1·5	..	..	3 1/2	70	32	..	..	..	..	..	102
898	1907 March 20	Off Lundeborg, close S of the harbour.	55°08′	10°47′	1—2	..	..	1 2/3	40	5	..	..	..	..	..	45
901	» » 22	S of Lundeborg.	55°07′	10°47′	1—2	2°4	20·4	5	247	74	..	..	..	..	..	321
903	» » 23	Off Spodsbjerg.	54°57′	10°52′	3—4	2°4	22·0	1	3	3	..	..	..	..	.	6
		The Baltic.														
704	1905 Nov. 16	Close W of Klintholm harbour, Møen.	54°57′	12°27′	1—2	..	..	1	..	..	.	..	..	..	..	0
705	» » 16	1 mile W of Raagelille, Møen.	54°58′	12°25′	1—2	..	..	3/4	..	..	..	..	..	..	..	0
706	» » 16	Southern side of Møen, 1 m. E of Tøvelde stone.	54°57′,8	12°22′,0	1—2	..	..	2/3	1	..	..	..	..	..	..	1

Table 1. Continued.

Station No.	Date	Place	Central Position N	Central Position E	Depth m.	Temperature & Salinity, surf. ° C.	Temperature & Salinity, surf. ‰	Duration of fishing hours	Pleuronectes platessa 0 gr.	I gr.	II gr.	III gr.	IV gr.	V+ gr.	? gr.	total No.
709	1905 Nov. 17	Southern side of Amager.	55°32′,5	12°35′	1—2	5°8	8·3	1	..	..	..	..	..	..	..	0
710	» » 17	Southern side of Amager.	55°33′,5	12°38′	1—2	5°8	8·3	1	..	..	..	..	..	..	..	0
888	1907 March 14	East coast of Falster, off S. Alslev.	54°45′	12°04′	4	0·9	10·6	3/4	..	..	..	..	..	..	..	0
889	» » 14	East coast of Falster, off Vigerløse.	54°42′	12°01′	2	..	..	2/3	..	..	..	..	..	..	..	0
1131	» July 24	Off Due Odde Light, Bornholm.	54°59′,5	15°05′	1—4	..	..	1	..	..	..	..	..	..	..	0
1132	» » 24	Off Due Odde Light, Bornholm.	54°59′	15°05′	4—6	..	..	1	..	..	..	..	..	..	..	0
1136	» » 25	S of Bornholm, at Gedebæk Odde.	55°00′	14°57′,5	2—4	..	..	1 1/2	..	..	..	..	..	..	..	0
1137	» » 25	S of Bornholm, at Gedebæk Odde.	55°00′	14°57′,5	6	14·1	7·5	1	..	..	..	..	..	..	..	0
1146	» » 27	Sandvig Bay, Bornholm.	55°17′	14°48′	2	..	..	1	..	1	..	..	..	..	..	1
1147	» » 29	Mill-bay, SE of Rønne.	55°04′,5	14°43′,5	1—4	..	..	4 1/2	..	3	7	..	..	..	..	10
1155	» August 2	South coast of Møen, off Rytsebæk.	54°54′	12°15′	1—4	..	..	3 1/2	..	1	..	..	..	..	..	1
1156	» » 2	South coast of Møen, off Rytsebæk.	54°54′	12°15′	6	..	..	1 1/2	..	..	..	..	..	..	..	0

B. Experiments by 50 f. Otter-trawl.

(An * by the station number indicates that an iron-chain has been attached to the foot rope.)

Station No.	Date	Place	Central Position N	Central Position E	Depth m.	Temperature & Salinity, surf. ° C.	Temperature & Salinity, surf. ‰	Temperature & Salinity on bottom or intermediate m.	Temperature & Salinity on bottom or intermediate ° C.	Temperature & Salinity on bottom or intermediate ‰	Duration of fishing hours	Pleuronectes platessa 0 gr.	I gr.	II gr.	III gr.	IV gr.	V+ gr.	? gr.	total No.
		The North Sea.																	
576	1905 Sept. 21	NW of Agger beacon.	56°46′	8°12′	13	14°2	32·8	13	14°1	32·7	2	5	32	30	11	9	1	3	91
577[1]	» 21 & 22	2 miles W of Thyborøn beacon.	56°42′	8°10′	12	14°1	32·4	12	14°0	32·4	6	1	15	40	32	43	17	9	157
587	» » 25	4 miles WNW of Graadeep Light-buoy.	55°29′	8°11′	6—7	13°3	32·2	6	13°3	32·2	2	73	315	137	18	2	..	4	549[2]
591[1]	» » 26	4 miles S of Vyl Light-vessel.	55°20′	7°46′	20	14°2	33·4	20	14°2	33·6	2	..	120	167	74	8	1	10	380[2]
593	» » 27	47 miles W by S of Horns Reef Light-vessel.	55°12′	6°08′	45	14°2		45	11°9	34·8	7	..	..	14	142	104	23	18	301
594	» » 27	SE of Tail End of Dogger Bank.	55°26′	5°35′	49	13°5		49	10°6	34.7	1	..	..	..	..	..	2	..	2
595	» » 27	SE of Tail End of Dogger Bank.	55°28′	5°50′	54	13°7		54	9°8	34·4	2	..	..	..	2	3	1	1	7
604	» Octbr. 3	24 miles W of Bovbjerg Light.	56°29′	7°25′	34	13°4	34·8	34	13°6	35·1	1	..	..	3	..	..	..	..	3
*956	1907 April 17	Off Thyborøn canal.	(56°46′	8°09′)	19	5°5	32·6	19	5°6	33·6	2	..	3	13	5	6	..	1	28
			(56°42′	8°07′)															
*975	» » 27	4 miles NNW of Graadeep Light-vessel.	55°25′	8°03′	15	5°9	32·4	15	5°9	32·6	2	..	1	68	64	25	1	2	161
*977	» » 27	Slugen, off Cancer.	55°29′	8°04′	22-32	6°2	31·8	32	6°4	31·8	1	..	3	19	26	1	..	3	52
*978	» » 29	3 miles SE by S of Slugen's NW buoy.	55°32′	7°52′	26	7°0	32·1	26	7°2	32·4	1	..	4	17	45	10	1	5	82
*980	» » 29	Slugen, 3 1/2 miles NW by W of the buoy.	55°35′	7°42′	15	6°1	32·6	15	5°9	32·6	1	..	5	7	15	3	..	3	33
*981	» » 29	2 miles NE af Vovov (Horns Reef).	55°34′	7°36′	8—11	5°9	33·1	11	5°7	33·1	1	..	4	34	96	4	1	2	141
*982A	» » 29	5 miles N by E 1/2 E of Vovov.	55°38′	7°35′	14-15	5°4	32·8	15	5°9	32·8	1	..	..	..	3	2	..	..	5
*983B	» » 30	5 miles NE 1/2 N of Horns Reef Light-vessel.	55°39′	7°24′	16-20	5°9	32·8	20	5°8	32·8	3	..	..	..	4	6	1	..	11
*984	» » 30	Westpoint of Horns Reef.	55°34′	7°30′	6—8	5°9	33·0	8	6°1	33·0	2	..	..	5	39	3	..	..	47
*985	» » 30	4 1/2 miles E by S of Horns Reef Light-vessel.	55°34′	7°27′	11-24	5°7	33·1	17	5°9	33·1	4	..	..	..	9	4	..	..	13
*986	» » 30	10 m. W by N 3/4 N of Horns Reef Light-vessel.	55°35′	7°02′	32	5°7	34·0	32	5°4	34·0	2	..	..	..	1	1	..	..	2
*987	» May 1	40 m. W by N 1/2 N of Horns Reef Light-vessel.	55°37′	6°08′	45	5°5	34·6	45	5°1	34·7	3	..	..	..	3	2	1	1	7
*988	» » 1	42 miles W of Horns Reef Light-vessel.	55°25′	6°08′	49	5°9	34·5	49	5°4	34·7	1	..	..	..	1	1	..	..	2
*989	» » 1	46 miles W by S of Horns Reef Light-vessel.	55°15′	6°08′	45	6°4	34·7	45	5°9	34·7	1	..	..	..	..	..	..	..	0
*990	» » 1	33 miles WSW of Horns Reef Light-vessel.	55°15′	6°32′	40	6°2	34·0	40	5°0	34·2	2	..	..	..	..	..	1	..	1
*991	» » 2	24 miles SW 1/2 W of Horns Reef Light-vessel.	55°15′	6°53′	30-34	5°7	33·7	34	5°6	33·7	1	..	..	..	..	1	..	1	2
*993	» » 4	4 miles ESE 1/2 E of Graadeep Light-vessel.	55°22′	8°15′	13	6°9	31·2	13	7°5	31·2	2	..	61	202	163	24	..	7	457
*995	» » 6	3 1/2 m. WSW 1/2 W of Graadeep Light-vessel.	55°20′	8°03′	17	7°1	31·1	17	6°8	31·1	1	..	2	17	39	11	..	2	71
*996	» » 6	5 miles S 3/4 E of Vyl Light-vessel.	55°19′	7°49′	22	6°7	32·2	22	5°8	32·3	1	..	..	..	1	1	1	..	3
*997	» » 6	8 miles W by S of Vyl Light-vessel.	55°20′	7°33′	26	6°2	33·3	26	6°2	33·5	1	..	..	..	..	..	..	..	0
*998	» » 6	12 m. S by W 1/2 W of Horns Reef Light-vessel.	55°22′	7°18′	28	6°0	33·7	28	5°8	33·7	1	..	..	..	1	..	1	..	2
*999	» » 6	18 miles WSW 1/2 W of Vyl Light-vessel.	55°15′	7°18′	26	6°2	33·2	26	5°9	32·2	1	..	..	..	1	1	..	..	2
*1000	» » 6	26 miles SW 1/2 W of Vyl Light-vessel.	55°03′	7°18′	27	6°2	33·1	27	5°9	33·4	1	..	..	..	1	1	1	..	3
*1001	» » 7	16 miles SSW 1/2 W of Vyl Light-vessel.	55°08′	7°37′	23	6°4	32·4	23	6°1	32·4	1	..	..	..	..	..	1	..	1

[1]) No. extra Cod-end. [2]) Only part of specimens investigated.

Table 1. Continued.

Station No.	Date	Place	Central Position N	Central Position E	Depth m.	Temperature & Salinity, surf. °C.	Temperature & Salinity, surf. ‰	Temperature & Salinity on bottom or intermediate m.	Temperature & Salinity on bottom or intermediate °C.	Temperature & Salinity on bottom or intermediate ‰	Duration of fishing hours	Pleuronectes platessa 0 gr.	I gr.	II gr.	III gr.	IV gr.	V+ gr.	? gr.	total No.
*1002	1907 May 7	11 miles SW ½ W of Graadeep Light-vessel.	55°13′	7°56′	18	7°0	31·2	18	6°9	31·2	1	..	2	24	39	12	2	2	81
*1005	» » 7	6 miles NW by W of Nymindegab.	55°50′	8°00′	20	8°6	31·6	20	6°5	32·3	1	..	2	16	7	1	..	..	26
*1006	» » 7	4 miles SW by W of Husby beacon.	56°08′	8°03′	16	8°4	31·8	16	7°5	31·9	1	..	8	12	1	1	..	1	23
*1008	» » 8	12 miles WNW of Husby Klit.	56°12′	7°45′	25	6°3	33·1	25	5°9	33·2	1	..	..	..	2	1	..	..	3
*1009	» » 8	24 miles NW by N of Blaavand point.	55°50′	7°35′	18	6°9	32·2	18	7°0	32·4	1	..	..	..	..	1	..	..	1
*1011	» » 9	24 m. WNW ¾ W of Horns Reef Light-vessel.	55°36′	6°37′	39	6°7	34·2	39	5°5	34·3	1	..	..	..	..	..	..	..	0
*1012	» » 10	27 miles NW ½ N of Horns Reef Light-vessel.	55°51′	6°43′	39	6°5	34·2	39	5°7	34·3	1	..	..	..	..	..	..	..	0
*1013	» » 10	36 m. N by W ¾ W of Horns Reef Light-vessel.	56°05′	6°48′	40	6°4	34·3	40	5°9	34·3	1	..	..	..	..	1	2	..	3
*1014	» » 10	31 miles W by N ¾ N of Lyngvig Light.	56°06′	7°11′	34	6°9	34·1	34	6°2	34·1	1	..	..	..	2	..	1	..	3
*1015	» » 10	32 miles W ¾ S of Bovbjerg Light.	56°18′	7°15′	34	7°0	34·3	34	5°8	34·3	1	..	..	..	2	..	..	..	2
*1016	» » 10	41 miles W of Bovbjerg Light.	56°22′	6°55′	37	6°2	34·5	37	5°2	34·5	1	.	..	..	2	1	1	..	4
*1077	» » 31	26 miles S by W ½ W of Lindesnæs Light.	57°32′	7°00′	210	8°5	29·9	210	5°9	35·1	1	..	..	..	..	..	..	..	0
*1078	» » 31	47 miles NW ½ W of Lodbjerg.	57°11′	7°00′	56	9°7	32·3	56	6°8	35·0	¼	..	..	..	..	..	..	..	0
		The Skagerak.																	
569[1]	1905 Sept. 19 & 20	2 miles NNE of Torup Strand.	57°10′	9°08′	6—9	13°8	32·4	7	13°7	32·3	4	..	329	35	11	1	1	3	380
605	» Octbr. 4	Tannis Bay, 5 m. N ½ W of Tversted beacon.	57°40′	10°08′	13-19	10°1	33·2	15	10°8	34·3	5½	3	94	114	9	9	..	7	236
606	» » 5	4 miles N by E of Spirbakken beacon.	57°46′	10°26′	40-70	10°7	33·7	70	10°9	33·9	1½	..	..	..	..	..	..	..	0
620	» » 11	15 miles NNE ½ E of Skagen Light-vessel.	58°00′	10°51′	194	10°0	29·0	194	7°2	35·1	1	..	..	..	..	..	..	..	0
622	» » 12	20 miles NW ¼ N of Højen.	57°58′	10°03′	80	11°2	33·1	80	10°5	34·5	1	..	..	..	..	..	..	..	0
659	» » 31	23 miles NW of Rubjerg Knude Light.	57°40′	9°11′	42	8°7	33·4	42	8°8	33·6	1	..	..	..	..	1	..	..	1
660	» » 31	29 miles NNE ½ E of Hanstholm.	57°35′	8°51′	70	8°8	33·4	70	9°5	34·3	1	..	..	..	1	1	..	..	2
661	» » 31	3 miles W of Rubjerg Knude Light.	57°26′	9°41′	17	6°8	33·2	17	6°8	33·3	½	..	2	..	..	..	..	..	2
665	» » 31	Tannis Bay, 10 miles E by N of Hirshals Light.	57°39′	10°14′	7—19	6°7	33·4	7	6°7	33·4	18	..	108	124	31	9	4	18	294
816	1906 Octbr. 5	Tannis Bay.	57°37′	10°12′	6	12°0	30·6	6	12°0	..	2	..	9	12	..	..	..	1	22
817	» » 5	Tannis Bay.	57°39′	10°12′	13	11°9	30·1	13	11°9	..	1	1	4	11	..	..	..	..	16
821	» » 5	Tannis Bay, 1 mile NW of Spirbakken Bn.	57°42′	10°26′	9	12°0	30·6	6	12°0	..	1	..	20	29	..	..	..	5	54
*934	1907 April 8	13 miles NNW of Hirshals Light.	57°45′	9°42′	33	5°3	35·0	33	6°9	35·0	2	..	..	6	12	5	1	1	25
*935	» » 8	22 miles NW ½ W of Hirshals.	57°45′	9°20′	60	5°4	34·9	60	6°5	35·0	1	..	..	..	..	..	..	..	0
*936	» » 9	30 miles NW ¾ W of Hirshals.	57°48′	9°07′	145	4°4	33·4	145	6°5	35·0	1	..	..	..	..	..	..	..	0
*940	» » 12	28 miles N ½ E of Hirshals.	58°03′	9°49′	220	4°4	32·7	220	5°8	34·9	1	..	..	..	..	..	..	..	0
*948	» » 15	Tannis Bay, off Tversted.	57°37′	10°10′	10	5°4	35·0	10	5°5	35·0	1	..	129	242	52	2	..	2	427
*951	» » 16	Jammer Bay, 3 miles NNE of Bulbjerg Bn.	57°12′	9°03′	12	5°1	34·2	12	5°8	34·2	1	..	17	111	13	6	..	1	148
*952	» » 16	Jammer Bay, 5 miles NW ½ N of Svinkløv Bn.	57°12′	9°11′	11	5°6	34·5	11	5°6	34·5	1	..	40	179	32	17	..	..	268
*953	» » 16	Jammer Bay, 5 miles N by W of Svinkløv Bn.	57°14′	9°18′	10	6°1	34·6	10	5°6	34·7	1	..	42	96	9	4	..	1	152
*954	» » 16	Jammer Bay, 14 miles N by W of Svinkløv Bn.	57°22′	9°08′	20	5°4	34·2	20	5°1	34·9	1	..	..	1	5	1	1	..	8
*1041	» May 16	13 miles WSW ½ W of Måseschär.	57°57′	11°02′	120	8°6	26·0	120	5°6	34·5	1	..	..	..	..	..	..	..	0
*1076	» » 30	11 miles S of Ryvingen Light.	57°47′	7°39	490	8°5	28·1	490	5°5	34·7	2	..	..	..	..	..	..	..	0
*1080	» June 1	26 miles N by W ½ W of Hanstholm.	57°29′	8°12′	120	7°6	31·1	120	6°1	35·1	1	..	..	..	..	..	..	..	0
*1091	» » 3	3½ miles N ½ E of Højen Light.	57°48′	10°33′	100	9°8	25·6	100	5°8	34·4	4	..	..	..	1	..	..	..	1
		The Kattegat and Sound.																	
563[1]	1905 Sept. 16	4 miles NE by E of Taarbæk Light-buoy.	55°50′	12°45′	22	14°3	15·4	22	12°3	27·6	½	..	..	2	1	1	5	..	9
565[1]	» » 17	N of Lille Lysegrund.	56°22′	11°27′	22	14°5	21·6	22	13°7	27·6	1	..	..	4	2	1	4	8	19
566[1]	» 17 & 18	8 miles NW by W of Tangen Light-buoy.	56°42′	10°43′	12	13°4	23·8	12	13°5	24·5	3½	..	9	41	8	..	..	11	69
567[1]	» » 18	5 miles SSW of Hals Light-vessel.	56°53′	10°22′	6—8	13°2	24·5	..	..	..	¾	..	1	..	..	..	..	..	1
607[1]	» Octbr. 6	6 miles N of Hirsholmene Light.	57°35′	10°38′	18	11°4	24·9	18	11°3	34·4	4½	..	60	41	..	2	..	4	107
613	» » 10	2 miles E by N of Nakkehoved Light.	56°08′	12°24′	9	10°8	18·1	9	11°0	18·5	¼	..	..	1	..	..	1	..	2
616	» » 10	3 miles NW of Svinbåden Light-vessel.	56°12′	12°27′	23	11°0	16·0	23	11°2	30·6	2	..	1	21	15	1	7	33	78
617	» » 10	7 miles WSW of Tylø Light.	56°35′	12°33′	23	10°4	18·7	23	10°3	32·9	2	..	..	14	18	..	4	12	48
618	» » 11	10 miles W ½ N of Paternoster Light.	57°53′	11°10′	60	10°5	25·1	60	11°1	34·6	1	..	..	..	..	1	1	..	2
619	» » 11	10 miles E ½ N of Skagen Light.	57°48′	11°00′	54	10°3	30·6	54	11°2	34·4	1	..	.	..	1	1	..	..	2
629	» » 13	5 miles SW of Skagen Light.	57°40′	10°33′	10	11°1	33·8	10	11°2	33·7	½	..	2	..	..	..	..	..	2
630	» » 13	7 miles SW by S of Skagen Light.	57°38′	10°33′	11	11°2	35·0	11	11°3	35·0	1	..	4	5	..	..	..	..	9
634	» 16 & 17	2 miles SSW of Trindelen Light-vessel.	57°24′	11°15′	32	8°8	25·1	32	11°1	34·4	20	..	2	55	37	24	7	20	145
639	» » 19	4 miles E by N of Læsø Rende Light-vessel.	57°14′	10°49′	9	7°3	23·3	9	8°2	24·7	1	..	1	3	..	..	..	1	5
644	» » 23	Herthas Flak, 9 miles SSE of Skagen Light.	57°37′	10°47′	26	7°4	24·0	26	11°0	34·3	4	..	8	10	..	2	..	10	30

[1]) No. extra Cod-end.

Table 1. Continued.

Station No.	Date	Place	Central Position N	Central Position E	Depth m.	Temperature & Salinity, surf. °C.	Temperature & Salinity, surf. ‰	Temperature & Salinity on bottom or intermediate m.	Temperature & Salinity on bottom or intermediate °C.	Temperature & Salinity on bottom or intermediate ‰	Duration of fishing hours	Pleuronectes platessa 0 gr.	I gr.	II gr.	III gr.	IV gr.	V+ gr.	? gr.	total No.
647	1905 Octbr. 25	4 miles E by N of Læsø Rende Light-vessel.	57°14′	10°49′	9	6°4	24·2	9	6°2	24·7	5	..	3	10	..	1	..	.	14
652	» » 26	9 miles SE by E of Hals Light-vessel.	56°54′	10°40′	13	7°1	21·9	13	7°3	23·4	2	..	3	3	3	..	..	4	13
658[1]	» 28 & 29	2 miles N of Hals Light-vessel.	56°59′	10°23′	6	5°4	23 4	6	4°9	23·2	12	68	39	4	..	..	..	1	112
671[1]	» Nov. 4 & 5	2½ miles SSW of Trindelen Light-vessel.	57°24′	11°15′	24-34	7°7	25·0	24	8°2	27·1	9	..	..	18	31	17	4	12	82
676	» » 9	N of Djursland, 5 miles WNW ½W of Gerrild Light.	56°33′	10°41′	9	7°7	20·3	9	8°8	29·4	½	1	..	1	..	..	..	..	2
683	» » 9 & 10	6 miles ESE of Fornæs Light.	56°25′	11°07′	18	6°9	15·6	18	11°0	32·7	4	..	3	16	40	7	29	38	133
718	1906 March 2	5 miles SSE of Humlebæk.	55°54′	12°38′	10-16	1°5	19·5	16	2°4	23·1	1½	..	..	3	1	..	2	1	7
723	» » 5	9 miles SW ¾ S of Hesselø.	56°04′	11°37′	19	1°8	18·2	19	4°8	31·0	1	..	..	6	2	1	3	14	26
727	» » 7	1½ miles E ¼ S of Yderby, Sjællands Odde.	55°59′	11°23′	14	1°9	18·8	14	3°7	29·4	½	..	..	..	2	1	5	..	8
737	» » 13	3½ miles S by W of Anholt Light.	56°41′	11°39′	24	2°3	25·5	24	3°0	29·6	1	..	..	..	..	1	..	..	1
740	» 15, 16 & 17	6 miles N by W ½ W of Kobbergrunden Light-vessel.	57°14′	11°18′	19-28	2°2 2°4	31·6 31·9	28 28	2°3 2°2	31·9[2] 32·0[3]	16	3	8	6	10	3	3	3	36
761	» » 27	8 miles S ½ W of Læsø Rende Light-vessel.	57°05′	10°43′	13	1°4	24·9	13	1°2	28 3	1	..	15	3	..	..	..	..	18
762	» » 27	3 miles SSE ½ E of Læsø Rende Light-vessel.	57°11′	10°45′	13	1°5	26·8	13	1°1	27·8	1	..	5	..	1	..	..	..	6
764	» 27 & 28	7 miles SE of Hals Light-vessel.	56°54′	10°35′	8	1°4	24·9	8	1°5	25·0	1	..	1	..	..	..	..	..	1
825	» Octbr. 8	Off Sæby.	57°18′	10°36′	5	12°2	23·6	..	..	..	1	..	27	4	..	..	..	1	32
828	» » 8-12	Læsø Rende, off NW Reef.	57°19′	10°45′	18-37	12°0	19·4	26	12°5	..	24	..	2	49	12	1	1	1	66
832	» » 13	Aalbæk Bay. Off Aalbæk.	57°35′	10°27′	7	12°2	20·6	..	..	..	1	1	85	222	..	..	..	4	312
833	» » 13	6 miles N of Hirsholmene.	57°35′	10°38′	18	12°1	28·9	..	..	..	1½	..	1	234	3	..	..	3	241
840	» » 15	Læsø Rende, off NW Reef.	57°19′	10°45′	18-37	11°4	23·3	25	12°3	..	2	..	..	3	..	..	..	..	3
847	» 19 & 20	E of Hals.	56°58′	10°23′	6	10°6	25·1	..	..	..	4	9	292	17	..	..	..	9	327
851	» » 22	6 miles SE by S of Skagen Light-vessel.	57°42′	10°52′	28	10°4	29·0	..	..	..	1	..	..	..	..	..	..	..	0
864	» » 25	Off Hevringholm. N of Djursland.	56°33′	10°33′	7—8	10°6	28·5	..	..	..	¼	..	..	..	..	..	..	..	0
870	» 26 & 27	11 miles WNW of Hallands Väderö.	56°29′	12°13′	33-38	9°7	18·1	..	..	..	2	..	..	..	..	..	1	1	2
871	» » 27	5 miles SE by S of Anholt Light.	56°39′	11°43′	30-37	9°8	17·7	..	..	..	3	..	1	3	1	..	1	..	6
872	» » 27	10 miles S by W of Anholt Light.	56°34′	11°38′	30	9°9	17·7	..	..	..	1	..	..	1	2	1	1	2	7
*928[1]	1907 April 3	6 miles ESE of Fornæs.	56°25′	11°07′	18	3°8	19·4	18	4°0	26·7	2	..	..	67	5	8	5	8	93
*929	» » 3	9 miles W by N ½ N of Ostebakken Light, Anholt.	56°44′	11°17′	17	3°7	19·4	17	4°5	22·7	2	..	..	1	4	4	13	1	23
*930	» » 4	4 miles SSE of Læsø NW Reef.	57°14′	10°50′	8	4°1	27·5	8	5°2	27·5	4	..	10	49	35	2	..	1	97
*931	» » 5	3 miles NNE of Læsø NW Reef.	57°21′	10°47′	28	3°9	27·5	28	4°2	33·3	3	..	1	3	11	1	2	..	18
*932	» » 6	4½ miles ESE of Sæby.	57°19′	10°40′	17	4°4	28·4	17	4°6	32·8	3	..	1	34	30	2	..	..	67
*933	» » 6	2½ miles E of Sæby.	57°20′	10°37′	7—10	4°7	28·6	8	5°2	28·5	2	..	25	82	33	7	..	1	148
*943	» » 13	6 miles N by E of Hirsholmene.	57°35′	10°38′	19	5°4	24·0	19	6°0	33·2	2	..	1	2	42	1	..	1	47
*946	» » 13	1 mile ESE of Aalbæk.	57°35′	10°27′	6—7	5°3	24·0	6	5°4	24·6	1	..	124	101	104	5	..	4	338
*947	» » 13	4 miles ESE of Aalbæk.	57°35′	10°32′	12	5°7	24·1	12	5°8	32·8	1	..	31	71	48	2	..	1	153
*1023	» May 13	7 miles NE by E of Hals Light-vessel.	57°02′	10°36′	10	7°1	22·5	10	6°7	24·4	1	..	..	8	21	..	..	3	32
*1024	» » 13	2 miles N of Hals Light-vessel.	56°58′	10°26′	7	11°2	23·6	7	8°3	26·3	1	..	14	6	..	..	..	.	20
*1042	» » 18	Herthas Flak, 10 m. SSE ½ E of Skagen Light.	57°37′	10°50′	26	8°4	20·9	26	5°8	33·8	1	..	..	19	11	2	1	..	33
*1043	» » 18	Herthas Flak, 5 miles S by E of Skagen Light.	57°40′	10°42′	23	8°7	21·5	23	6°2	33·8	1	..	2	29	26	2	..	1	60
*1046	» » 21	4½ miles N of Nordre Rønner Light.	57°26′	10°54′	26	8°5	22·4	26	5°9	33·3	1	..	1	12	4	3	..	..	20
*1067	» » 24	5½ miles NNE of Anholt Light.	56°50′	11°42′	24	10°4	16·5	24	5°2	30·5	1	..	..	..	..	..	1	..	1
*1070	» » 25	2 miles S of Trindelen Light-vessel.	57°24′	11°15′	24	11°1	20·8	24	7°1	33·1	2	..	1	3	11	3	1	2	21
*1071	» » 25	13 miles N of Trindelen Light-vessel.	57°39′	11°12′	42	10°5	20·1	42	7°0	32·0	1	..	..	1	1	2	2	..	6
*1072	» » 27	3 miles ESE of Hulsig.	57°39′	10°33′	10	10°6	22·4	10	8°7	30·2	1	..	48	64	41	4	..	1	158
*1095	» June 4	2½ miles E by N of Hulsig.	57°40′	10°32′	9	10°2	20·6	9	7°5	28·7	1½	..	110	146	47	7	1	21	332

[1]) No extra Cod-end. [2]) March 15. [3]) March 17.

Table 1. Continued.

Station No.	Date	Place	Central Position N	Central Position E	Depth m.	Temperature & Salinity, surf. ° C.	Temperature & Salinity, surf. ‰	Temperature & Salinity on bottom or intermediate m.	Temperature & Salinity on bottom or intermediate ° C.	Temperature & Salinity on bottom or intermediate ‰	Duration of fishing hours	Pleuronectes platessa 0 gr.	I gr.	II gr.	III gr.	IV+ gr.	? gr.	total No.
		The Belt Sea.																
688	1905 Nov. 11	Great Belt, off Kerteminde.	55°26′	10°48′	19	7°2	10·4	19	8°2	20·9	2	..	1	3	5	7	1	17
693	» » 13	4 miles SW 1/2 S of Bagenkop harbour.	54°42′	10°37′	21	7°3	10·7	21	8°5	17·2	2	..	..	4	..	73	2	79
700	» » 15	Fehmern Belt, 4 miles E of the Light-vessel.	54°37′	11°15′	21	7°1	8·2	21	7°3	8·1	1/2	..	..	..	..	3	1	4
860	1906 Octbr. 24	Sælvig, Samsø.	55°55′	10°30′	22	10°9	21·3	..	..	..	1/4	..	2	..	..	1	..	3
*891[1])	1907 March 15	4 miles WSW of Bagenkop harbour.	54°43′	10°35′	25	1°4	17·2	25	3°5	18·1	3/4	..	1	8	7	209	29	254[2])
893	» » 17	3 1/2 miles ENE of Tranekjær Light.	55°01′	10°58′	16	1°5	16·5	16	1°6	16·6	2/3	1	3	2	5	32	5	48
897	» » 20	2 miles E 1/2 N of Elsehoved.	55°07′	10°49′	14	2°2	20·0	14	2°3	19·9	1 1/2	8	23	..	3	..	11	45
		The true Baltic.																
707	1905 Nov. 16	4 1/2 miles ESE of Hestehoved.	54°49′	12°18′	22	5°8	7·5	22	6°9	7·6	1	..	1	8	7	45	13	74
708	» » 16	5 miles WSW of Møen Light.	54°54′	12°26′	21	5°9	7·4	21	7°0	7·5	5	..	2	41	25	398	36	502
*885[1])	1907 March 13	11 miles N 1/2 E of Darsserort.	54°39′	12°29′	17	0°6	9·2	17	2°6	10·3	12 ♂	76	50	40[2])	52[2])	826[2])	109[2])	1153
											12 ♀	43	33	21	74	102[2])	12	285
*908	» » 24	Off Zingst.	54°32′	12°45′	14	3°0	11·6	14	3°9	13·0	1	25	10	4	3	13	2	57
*911	» » 25	15 miles ESE of Ranzow Light (Rügen).	54°32′	14°04′	17	1°5	8·3	17	3°7	8·3	1 1/2	7	4	5	4	15	..	35
*912	» » 25	16 miles NE 1/2 E of Arkona Light.	54°52′	13°44′	47	1°8	8·0	47	2°2	13·7	1 1/2	..	1	5	8	29	3	46
*915	» » 26	7 miles SW by W of Møen Light.	54°52′	12°25′	17	1°7	8·5	17	2°8	12·2	2	23	27	14	36	163[2])	23[2])	286
1124	» July 23	19 miles SE by E 3/4 E of Jasmund, Rügen.	54°29′	14°12′	13	13°5	7·6	11	13°5	7·6	1	..	..	..	..	..	..	0
1125	» » 23	Oder Bank, 17 miles E 1/4 N of Greifswalde.	54°19′	14°24′	8	15°2	7·7	7	14°6	7·6	1	..	..	..	..	..	..	0
1144	» » 26	19 miles NW 1/2 N of Scholpin Light.	54°56′	16°52′	14-17	13°8	7·5	17	12°4	7·3	1/2	..	..	..	..	..	..	0
1145B	» » 27	18 miles SE 1/2 E of Christiansø.	55°10′	15°38′	90	14°5	7·3	90	5°0	16·7	1/2	..	..	..	..	..	..	0
1148	» » 30	5 miles ESE of Nexø.	55°03′	15°16′	73	14°5	7·6	70	4°8	14·6	1	..	..	..	..	14	..	14
1151	» » 31	6 miles SE 1/4 S of Jasmund Light.	54°30′	13°50′	16	14°6	7·3	16	14°6	7·7	1/2	..	..	..	1	4	..	5
1154	» August 2	6 1/2 miles SW 1/2 W of Møen Light.	54°52′	12°25′	17	15°1	8·6	17	12°5	12·0	1	..	45	8	11	106	5	175

C. Experiments by Young fish trawl.

(* Trawl provided by an iron-chain. † Trawl provided by wings and iron-chain.)

Station No.	Date	Place	Central Position N	Central Position E	Depth m.	Temperature & Salinity, surf. ° C.	Temperature & Salinity, surf. ‰	Temperature & Salinity on bottom or intermediate m.	Temperature & Salinity on bottom or intermediate ° C.	Temperature & Salinity on bottom or intermediate ‰	Duration of fishing hours	Pleuronectes platessa 0 gr.	I gr.	II gr.	III gr.	IV gr.	V+ gr.	? gr.	total No.
		The southern Kattegat.																	
1115	1907 June 8	2 miles E by S of Nakkehoved.	56°07′	12°24′	10	10°4	11·9	10	10°6	19·3	1/2	..	..	3	..	1	1	..	5
		The true Baltic.																	
†1126	» July 23	7 miles NE 3/4 E of Greifswalde Oie.	54°20′	14°04′	15	15°3	7·8	15	14°1	7·6	1 1/2	1	16	..	1	..	1	..	19
†1127	» » 23	16 miles N 1/2 W of Gross Horst.	54°21′	14°56′	14	13°1	7·3	14	12°5	7·3	1/2	..	2	1	1	2	4	..	10
*1138	» » 25	8 miles SSW 1/2 W of Rønne harbour.	54°58′	14°37′	17	14°0	7·6	17	12°7	7·7	1/2	..	..	1	.	1	4	..	6
*1151	» » 31	6 miles SE 1/4 S of Jasmund Light, Rügen.	54°30′	13°50′	16	14°6	7·3	16	14°6	7·7	3/4	..	3	..	..	1	..	..	4
*1152	» August 1	6 miles NE by E 1/2 E of Jasmund Light.	54°38′	13°49′	24	15°0	7·4	24	14°6	7·7	2	..	24	1	1	3	6	..	35
*1153	» » 1	10 miles E by N of Darsserort Light.	54°32′	12°45′	13	15°7	8·1	13	15°8	8·3	1/4	..	..	..	..	1	..	..	1
†1157	» » 3	11 miles N 1/2 E of Darsserort.	54°39′	12°29′	17	14°7	9·3	17	14°9	9·8	1 1/2	..	14	..	3	1	10	1	29
*1158	» » 3	6 miles NE 1/2 E of Darsserort.	54°32′	12°38′	10	14°8	8·1	10	14°8	8·6	1/4	..	..	..	..	2	..	..	2
*1159	» » 3	11 miles NE 1/2 E of Darsserort.	54°36′	12°43′	17	14°9	8·1	17	15°0	9·5	1/4	..	..	..	..	1	1	..	2
*1160	» » 3	Plantagenet Ground.	54°39′	12°48′	8	14°9	8·7	8	14°8	9·0	1/4	..	2	..	..	..	..	..	2
†1161	» » 3	11 miles NNW of Dornbusch Light.	54°45′	12°58′	30	14°4	8·0	30	14°3	8·6	1/2	..	..	..	..	1	3	..	4
†1162	» » 3	11 miles SE of Møen Light.	54°50′	12°48′	21	13°8	7·7	21	13°0	7·8	2 1/2	10	82	4	4	9	45	..	154
†1163	» » 3&4	11 1/2 miles SE 3/4 S of Møen Light.	54°49′	12°47′	19	13°9	7·7	19	14°2	8·5	2	7	63	3	3	5	38	1	120

[1]) No extra Cod-end. [2]) Only part of specimens investigated.

III. Variation in the frequency of young Plaice in the middle and southern Kattegat (S. of 57° N. Lat.), the Belt Sea and the Baltic.

A. The bottom stages of plaice.

1. Investigations between 1893 and 1901.

For a series of years investigations concerning the distribution of young plaice off our coasts have been carried on from the Danish Biological Station under the direction of Dr. C. G. Joh. Petersen. As a result which is of interest in this connection, it may be stated that the investigations suggest that only proportionately small quantities of fry were present at the southern Danish isles in the years 1893 and 1900. Concerning the evidence to hand we will here refer to the Reports IV and XII from the Danish Biological Station.

From the German side investigations concerning the occurrence of young plaice in certain places off the coast of the western Baltic have been carried on in most of the years between 1893 and 1899. Apstein states, on the basis of rather extensive investigations, that young plaice in 1893 and 1895 were wanting or only occurred very scantily in Eckernförde Bay and at Kiel, while they were quite plentiful at these places in 1897, 1898 and 1899[1]. Apstein takes for granted that unfavourable spawning years will influence the total catch in certain of the ensuing years, and he institutes a comparison between good and bad spawning years and the yield of the fishery in the following years, as it is represented in the Eckernförde statistics.

In the years 1894, 1896 and 1901, the investigations concerning the presence and frequency of young plaice were so scattered both on the part of Denmark and Germany, that it has not been possible to ascertain if these years should be reckoned with the more or less favourable years for the presence of the fry here, not even within very limited areas.

In our investigations we shall take the year 1902 as a starting point, and try to carry the matter a step further by comparing a series of observations concerning the distribution and frequency of young plaice in the middle and southern Kattegat, the Belt Sea and the Baltic in the years 1902—1907.

2. Investigations from the Danish Biological Station in the years 1902, 1904 and 1905.

In the year 1902 an extensive investigation was carried on by Dr. Johs. Schmidt concerning the distribution and frequency of the young plaice in the Danish waters east of the Skagen. Regarding this investigation, which was carried on from the Danish Biological Station, the Director of the Station, Dr. Petersen, has given an account in Report XII from the Danish Biological Station. In the search for the young plaice some hand shove nets were used in quite shallow water, where it was not too deep for wading, and the journal kept by Dr. Schmidt enables us, as a rule, to see how many plaice of the 0-Gr. one man was able to catch in the course of one hour with a hand shove net. In some cases information is given moreover as to the maximum capture of plaice per haul of a certain length.

The hand shove nets used were not always of the same kind. In the early summer, when the fry was small, nets of a closer material were employed than later in the summer, when the fry was larger, and the same was the case in the following years. With regard to the size of the nets used see p. 5.

For the year 1902 we might as the fishing unit choose one man's fishing in one hour. This unit is however not the same as was employed by the Danish Biological Station in the years 1904 and

[1] C. Apstein: Junge Butt (Schollen, Pleuronectes platessa) in der Ostsee. Wissenschaftl. Meeresunters. N. F. Bd. 8. Abt. Kiel. 1904.

1905. In the investigations which were carried on in these years by Mr. OTTERSTRØM, and of which an account has been given in Rapports et Procès-verbaux vol. V 1906 by Dr. JOH. PETERSEN, 50 or 100 meters' haul with hand shove net was used as the fishing unit. In experiments carried on from the "Thor" it has however, appeared, that one single man's fishing in one hour corresponds, on an average, to hauls of a total length of ca. 400 meters. This average value is naturally in the separate cases not quite the exact equivalent. When many small plaice are caught, it will naturally take longer time to pick them up from the net than when few and large plaice are caught. But the conversion of "fishing per man and per hour" into "fishing per 100 meters' haul" has been done to enable us to form an idea how far many or few plaice of the 0-Gr. have appeared in certain of our waters in 1902 compared with the years 1904 and 1905.

By means of the treatises published by Dr. PETERSEN and of the journals of the Danish Biological Station, which Dr. PETERSEN has kindly placed at my disposal, I have on the charts of Fig. 1 represented the result of the capture of the 0-Gr. by hand shove net in the three years 1902, 1904 and 1905. For the last year the results of some German coast investigations with hand shove net have also been put down after PETERSEN and REIBISCH.

In the charts of Fig. 1 it is obvious at a glance that far less plaice of the 0-Gr. have been caught in 1904 in the middle and southern Kattegat and in the Belt Sea, both in total and per 100 meters' haul, than in 1902 and 1905. If we compare some localities where plaice of the 0-Gr. have been looked for during all the three years, we obtain the following result, which indicates the capture of specimens per 100 meters' haul:

	1902	1904	1905
Skansehage, Isefjord	13	0	20
Kerteminde, Great Belt.....	90	5	70
Spodsbjerg, Langeland	68	12	16

Fig. 2 gives a graphic representation of the average capture per station and per 100 meters' haul in the three areas: the middle and southern Kattegat, the Sound, and the Belt Sea. It will be seen that the quantity of the fry was greatly reduced in the year 1904 compared with the years 1902 and 1905.

3. The German investigations in 1903—1906.

As a link in the international co-operation for the study of the sea, a series of investigations has been carried on from the German side concerning the distribution of young plaice off the German coasts of the western Baltic and the true Baltic in the years 1903 to 1906. From the investigations which have been undertaken, we are unable to form any well-founded opinion on the variation in the frequency of the fry from one year to another. So much has, however, been ascertained, that numerous specimens of the 0-Gr. were present in certain parts of the western Baltic in all these years. Even in 1904, when so few specimens of the 0-Gr. were present in the southern Kattegat and in the Belts, numerous specimens were caught in Neustädter Bay (by Duncker). Off the coasts of the true Baltic east of Darserort there were, on the contrary, only quite a few specimens captured, in certain years none[1].

Some captures from the German coast investigations in 1903, 1904 and 1905 are represented on Figs. 2 and 3.

[1] See: A. KRÜGER: „Über die Verbreitung junger Schollen an der deutschen Ostseeküste im Sommer und Herbst 1903." Mitt. Deutsch. Seefischerei-Vereins. Bd. XIX. 1903. Another treatise in Bd. XX. 1904. — G. DUNCKER: „Junge Goldbutt (*Pleuronectes platessa* L.) in der Neustädter Bucht" ibd. Bd. XX 1904. — EHRENBAUM & STRODTMANN: „Eier und Jugendformen der Ostseefische I. Bericht". Wissensch. Meeresunters. N. F. VI. Abt. Helgoland. 1904. — J. REIBISCH: „Weitere Untersuchungen über die Verbreitung junger Schollen an der deutschen Ostseeküste im Sommer 1904." Mitt. Deutsch. Seefischerei-Vereins. Bd. XX. 1904, und „Über die Verbreitung junger Plattfische des ersten Jahrganges an der deutschen Ostseeküste in den Jahren 1905 und 1906" ibd. Bd. XXIII. 1907. STRODTMANN: „Laichen und Wandern der Ostseefische. II. Bericht". Wissensch. Meeresunters. N. F. VII. Bd. Abt. Helgoland. 1906.

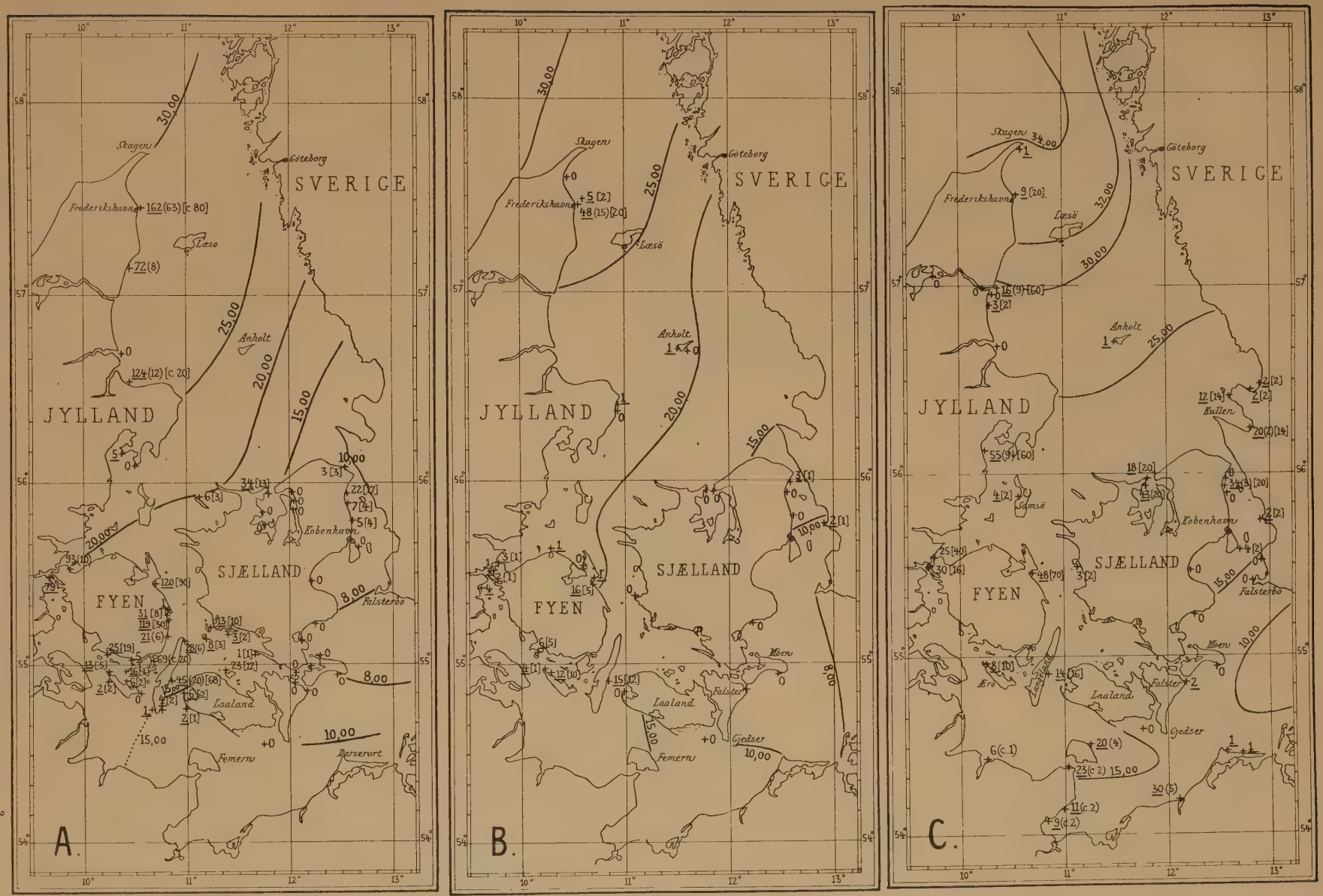

Fig. 1. No. of plaice of the 0-Gr. caught by hand shove net. { A. 1902. June—September. B. 1904. June—September. C. 1905. June—July.

Figure without brackets = total catch. Figure in () = maximum catch per haul. Figure in [ ] = catch per 100 meters' haul
The curves are surface isohalines for the first days of February.

4. Investigations from the Danish research steamer "Thor" from 1903—1907.

The deduction which may be drawn on the basis of the investigations from the Danish Biological Station, that young plaice of the 0-Gr. were present in far lesser quantities in the southern Kattegat and in the Belts in 1904 than in 1902 and 1905, becomes of great importance when regarded in the light of the results which were gained through more extensive investigations from the "Thor" from 1905—1907. We have by these investigations procured considerable material to prove that only slight quantities of the young of plaice were developed in 1904 in the middle and southern Kattegat and the Belts in proportion to what occurred in the preceding and two ensuing years, and this material has partly

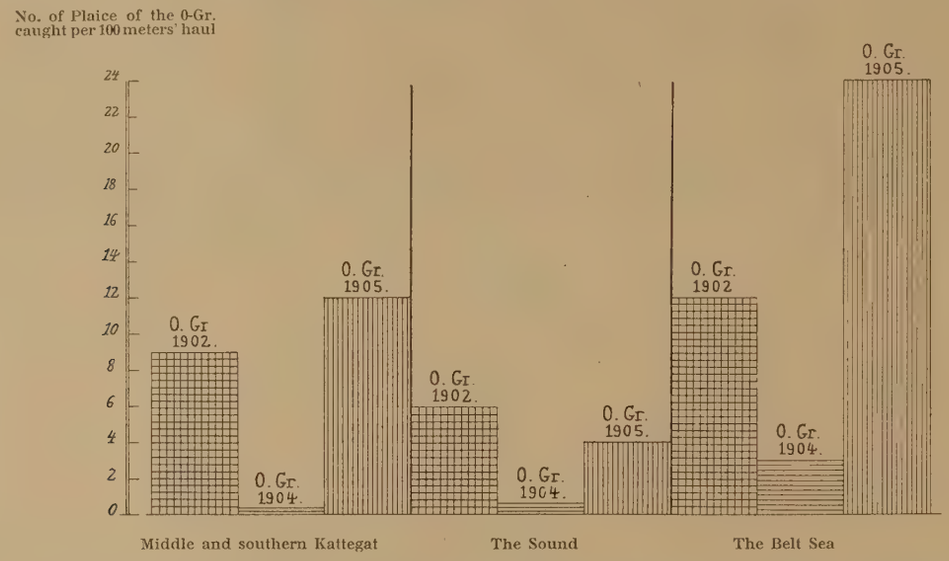

Fig. 2. Graphic representation of the average number of plaice of the 0-Gr. caught per 100 meters' haul per station[1]) by hand shove net from the Danish Biological Station. June—September 1902, 1904, 1905. (Concerning the number of stations in the different waters see Fig. 1).

been procured through fishing experiments in deeper water, where the captured plaice were subjected to an otolith investigation.

The investigations which were carried on from the "Thor" in 1903 and 1904 were of a spread character.

In Fig. 3 is represented the number of plaice of the 0-Gr. which have been caught per haul or per hour by different apparatus from the "Thor". Some captures from the Danish Biological Station and from the German side have also been drawn up here. It will be seen that the few investigations, which were carried on in the southern Kattegat and the Belts, suggest that a smaller capture of the 0-Gr. has taken place in 1904 than in 1903.

In Neustädter Bay we find that considerable captures were made both in 1903 and 1904.

In the autumn of 1905, autumn of 1906, and in the spring and summer of 1907, the regular coast investigations were undertaken in the Kattegat and the Belt Sea, chiefly with the aim to investigate the frequency of the 0-Gr. and I-Gr. of the plaice. The investigations were made at depths between 0 and 6 meters and the fishing unit which was chosen, was that of one hour's haul by Young plaice trawl.

In Fig. 4 a representation is given of the captures of the plaice of the 0-Gr. in the three years 1905—1907. As the investigations in 1907 have been carried on in another season than

[1]) The capture has first been calculated per 100 meters' haul for each station, and the average has thereafter been taken for all the stations in question.

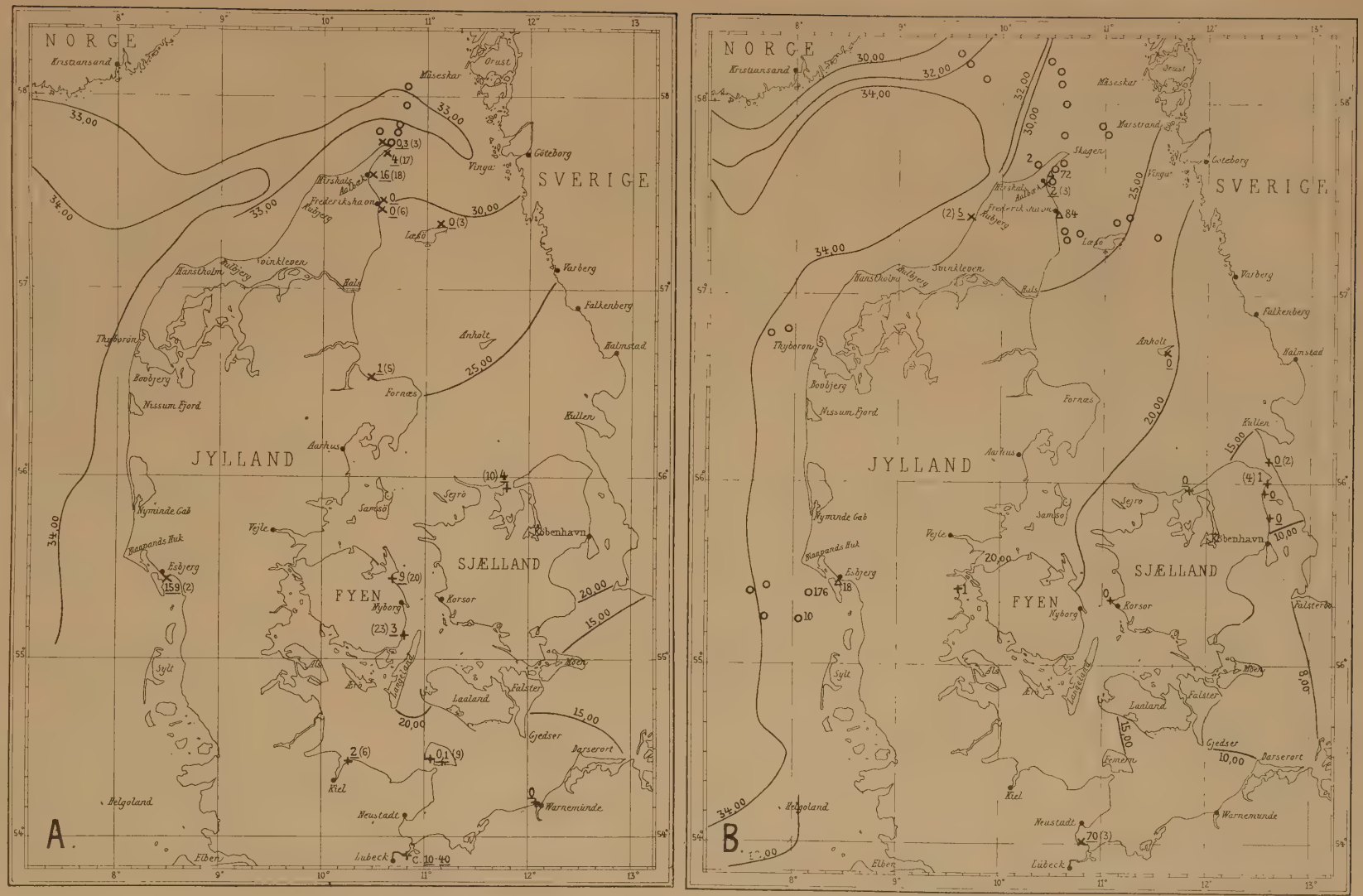

Fig. 3. No. of plaice of the 0-Gr. caught by different apparatus { A 1903. August—November. B. 1904. August—October.

× Eel seine
+ Small meshed seine
△ 11 feet Beam-trawl — catch per hour.
o Young fish trawl — catch per hour. (If no figure, no capture of 0-Gr.)

} Figure without brackets = catch per haul.
} Figure in brackets = number of hauls.

The curves are surface isohalines for the first days of February.

in the two preceding years in the waters E. of 9° 40 E., we must show great caution in taking the results from this year into the comparison.

With regard to the 0-Gr. it is conspicuous that it occurred in considerably greater numbers in 1906 than in 1905. This was a prevailing feature, as will be seen from Fig. 6, not only for the middle and southern Kattegat and Belts, but also for the northern Kattegat. The capture of the 0-Gr. per station and per hour was in 1906 about twice as great as in 1905.

Table 2. Number of plaice of the various age-groups captured in the southern Kattegat and the Baltic in 1907. Young fish trawl. 8—30 m. Otolith investigations.

Date	Area	No. of Stations	Duration of fishing	Hatching year for the Plaice				
				1903	1904	1905	1906	1907
1907 June	Southern Kattegat	1	1/2	1	0	3	0	0
» July—August	True Baltic	13	10 3/4	27	13	10	206	18
	Total No. of specimens			28	13	13	206	18

The most noticeable result of the investigation is, however, the exceedingly scarce capture of specimens of the I-Gr. in the autumn of 1905.

How small this capture has been, is plainly seen on Fig. 5 and Fig. 7 and on Table 4, which represents a complete review over the capture of plaice on the coast stations in the southern Kattegat,

Table 3. Number of plaice of the various age-groups captured in the middle and southern Kattegat, the Belt Sea, and the Baltic in the years 1905—1907. 50 f. otter-trawl. 5—47 m. Otolith investigations.

Date	Area	Depth meters	No. of Stations	Duration of fishing, hours	Hatching year for the Plaice				
					1902	1903	1904	1905	1906
1905 Septbr.—Nov.	Middle and southern Kattegat	5—23	11	28 1/2	87	107	56	69	..
1906 March	»	8—24	5	5	5	9	1	0	..
» Octbr.	»	6—38	5	10 1/4	1	3	21	293	9
1907 April—May	»	7—24	4	6	?	12	9	74	14
1905 Nov.	Belts	19—21	3	4 1/2	5	7	1	0	..
1906 Octbr.	»	22	1	1/4	1	0	0	2	0
1907 March	»	14—16	2	2 1/6	?	8	2	26	9
1905 Nov.	True Baltic	21—22	2	6	32	49	3	0	..
1907 March	»	14—47	5	18	?	125	49	75	98
» July—Aug.	»	16—17	2	1 1/2	?	16	12	8	45
	Total No. of specimens				?	336	154	547	(175)

the Belt Sea and Baltic in 1905—1907. In Fig. 7 the captures of the annual series from 1904 and 1905 have been compared, and it will be seen that the latter series completely dominates the former.

It may also be seen in Table 4 that the series from 1904 has been far more scantily represented than the series from 1905 and 1906. It is especially interesting to notice that, while no specimens of the I-Gr. were caught in the Belt Sea during the coast investigations of 1905, a considerable number of specimens of the I-Gr. were caught in the autumn of 1906 and in March, 1907, mainly in the same localities.

That we found far more specimens of the 0-Gr. and I-Gr. in the coast investigations in 1906 than in 1905 might be supposed to be due to the circumstance that the young plaice had migrated earlier out into deeper water in 1905 than in 1906. But in this case we should have found them at the trawling stations, of which several were taken in the autumn of 1905 at depths between 5 and 24 meters. It will,

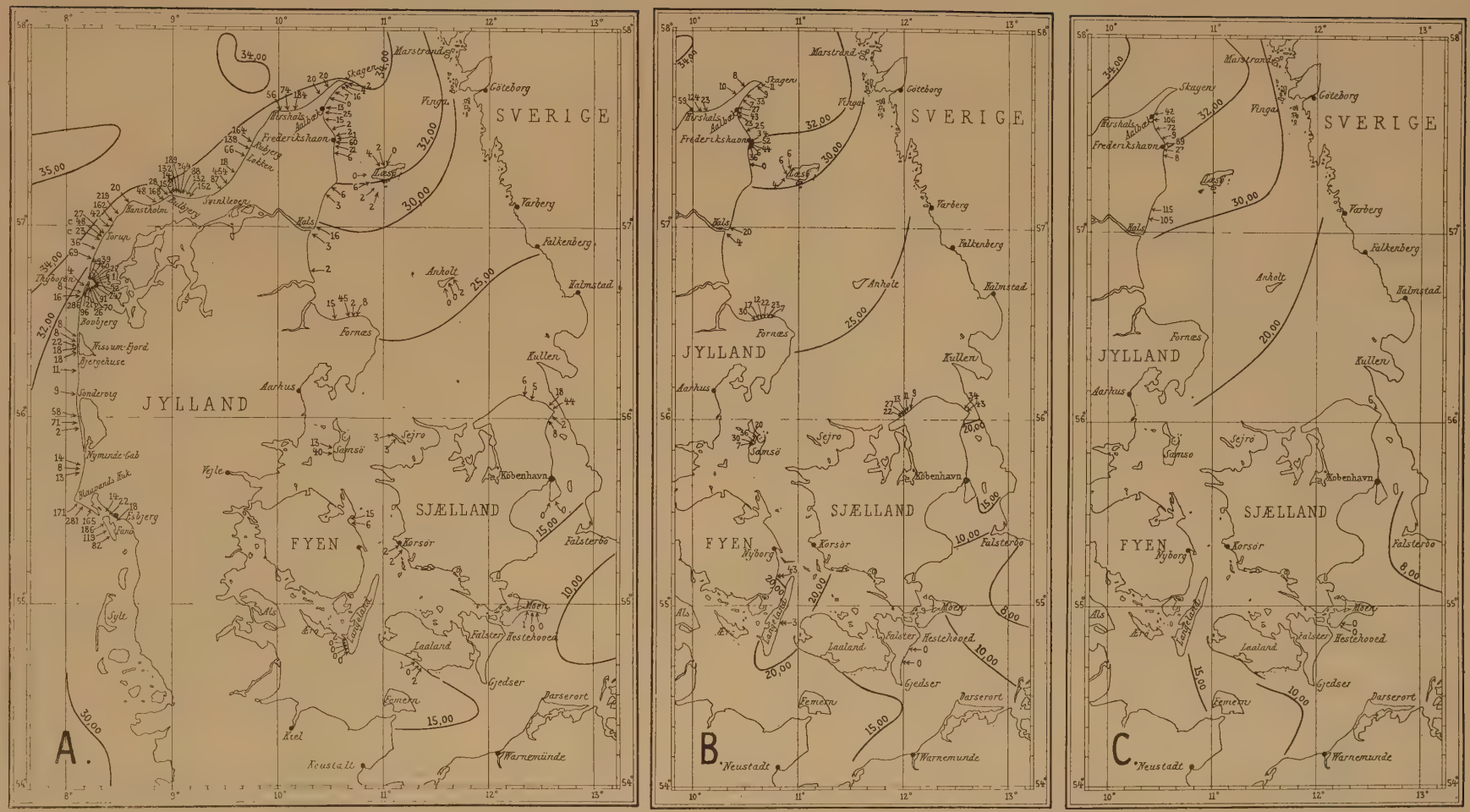

Fig. 4. Number of plaice of the 0-Gr. caught per hour by Young plaice trawl.

- A. 0-Gr. 1905. June—Septbr. (W of 9° 40′ E). October—Nov. (E of 9° 40′ E).
- B. 0-Gr. 1906. October— (one arrow head). March 1907 (two arrow heads).
- C. 0-Gr. 1907. August.

The curves are surface isohalines for the first days of February.

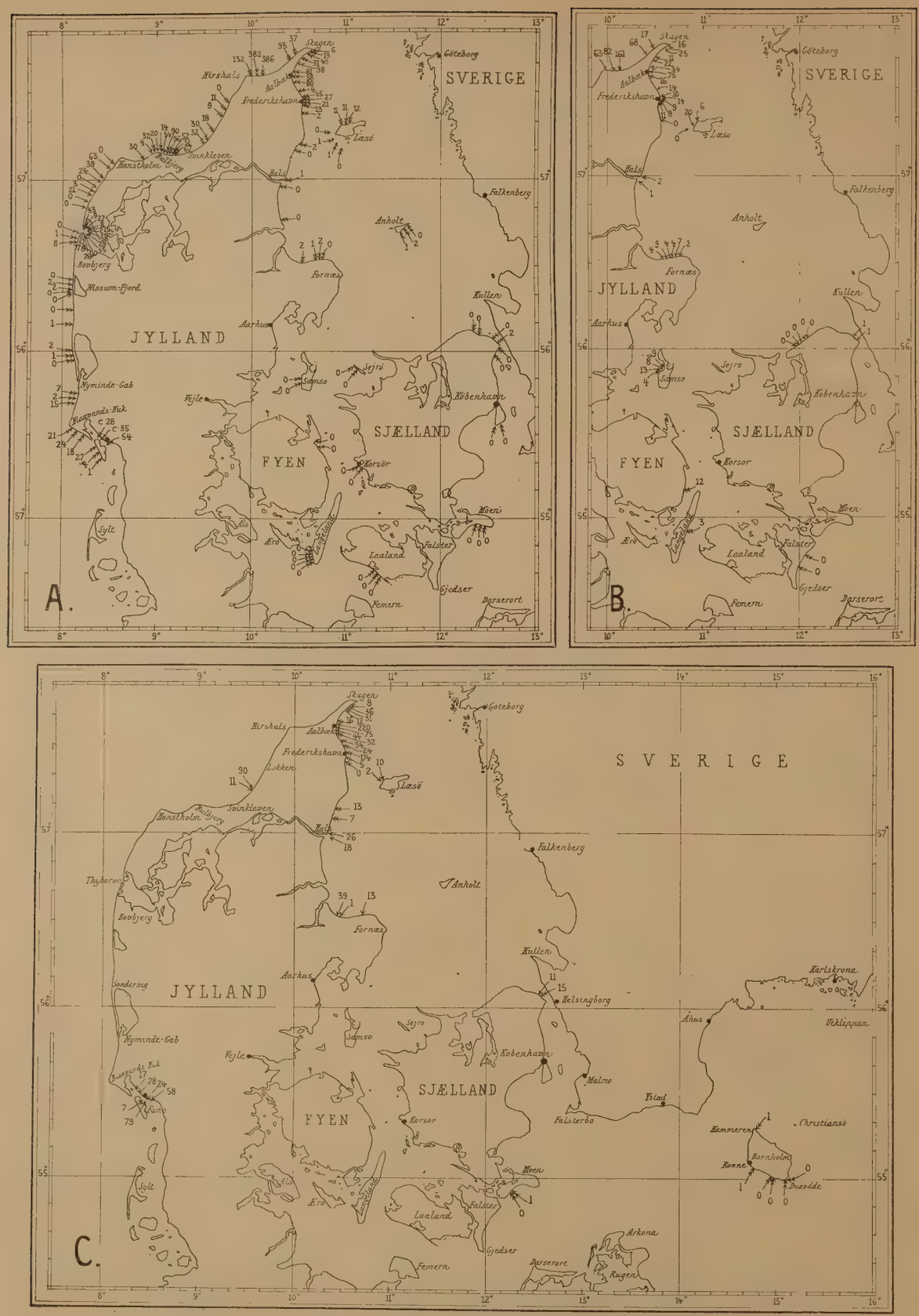

Fig. 5. No. of plaice of the I-Gr. caught per hour by Young plaice trawl.

A. I-Gr. 1905. (hatched in 1904) June—August 1905 (one arrow head).
September—November 1905 (two arrow heads).

B. I-Gr. 1906. (hatched in 1905) October 1906 (one arrow head). March 1907 (two arrow heads).

C. I-Gr. 1907. (hatched in 1906) April—June 1907 (one arrow head). July—August 1907 (two arrow heads).

Table 4. Number of plaice of the various age-groups captured in the middle and southern Kattegat, the Belt Sea and the Baltic in the years 1905—1907. Young plaice trawl. 0—5 m. Otolith investigations

Date	Area	No. of Stations	Duration of hauls, hours	Hatching year for the Plaice			
				1904	1905	1906	1907
1905 Septbr.—Nov.	Middle and southern Kattegat	16	20	20	254	..	..
1906 March	»	1	1	0	1	..	..
» Octbr.	»	15	34 1/4	0	65	649	..
1907 May—June	»	6	7	0	11	133	5
» August	»	1	1	0	0	15	6
1905 Nov.	Belts	8	7 5/6	0	89	..	..
1906 Octbr.	»	4	9 1/2	0	82	249	..
1907 March	»	3	7 2/3	0	82	290	
1905 Nov.	Western Baltic	8	8	0	5	..	.
1905 Nov.	True Baltic (Möen)	5	4 5/12	0	1	..	.
1907 March	» (Falster)	2	1 5/12	0	0	0	..
» July	» (Bornholm)	6	10	0	7	4	0
» August	» (Möen)	2	5	0	0	1	0
	Total No. of specimens			20	597	1341	(11)

however, be seen from Table 1 (p. 7) as well as from Figs. 7, 9 and 10 that only very few specimens were caught at the trawling stations, not only of the 0-Gr. but also of the I-Gr.

The results gained by the coast investigations are confirmed and supplemented by investigations on the frequency of specimens of the various age-groups of plaice occurring in deeper water.

In Tables 2 and 3 the results are represented of an otolith investigation of plaice caught by Young fish trawl and 50 f. otter-trawl in the middle and southern Kattegat, the Belt Sea and the Baltic in 1905—1907. The Tables show plainly that the series from 1904 has been far more scantily represented in the captures than the preceding and the two ensuing annual series.

The Tables comprise only the 4 or 5 youngest series, as the age of the older series could not be determined with certainty.

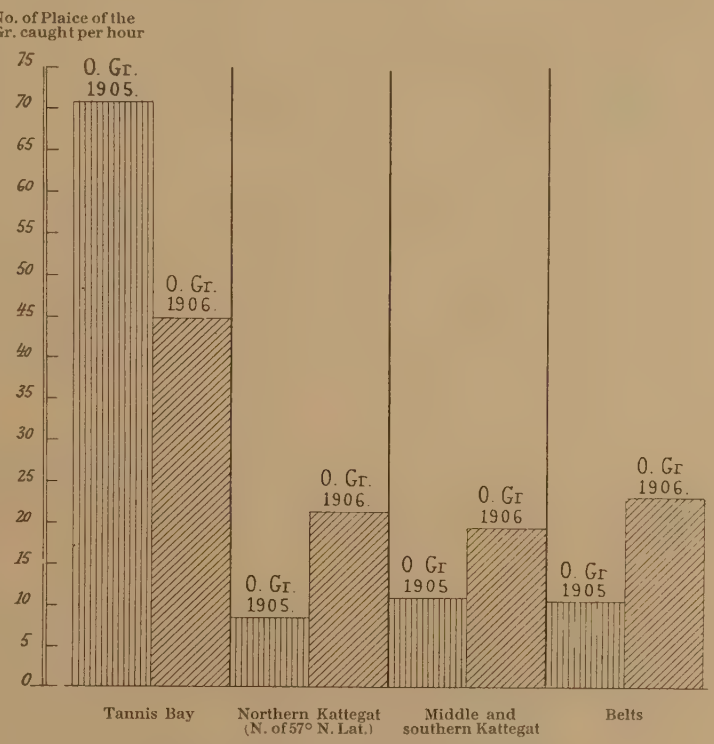

Fig. 6. Graphic representation of the average catch of plaice of the 0-Gr. per station and per hour[1]) by Young plaice trawl.
0-Gr. 1905 caught in Septbr.—Nov. 1905.
0-Gr. 1906 caught in October 1906 and, as regards the Belts, in March 1907.
Concerning the number of stations in the different waters see Table 1 and Fig. 4.

[1]) The capture has first been calculated per hour for each station, and the average has thereafter been taken for all the stations in question.

Fig. 8 represents in schematic form the fact, that the specimens originating from 1904 were far more slightly represented as II-Gr. in the southern Kattegat than those which originate from 1903 and 1905. This may also be seen from the charts in Fig. 11.

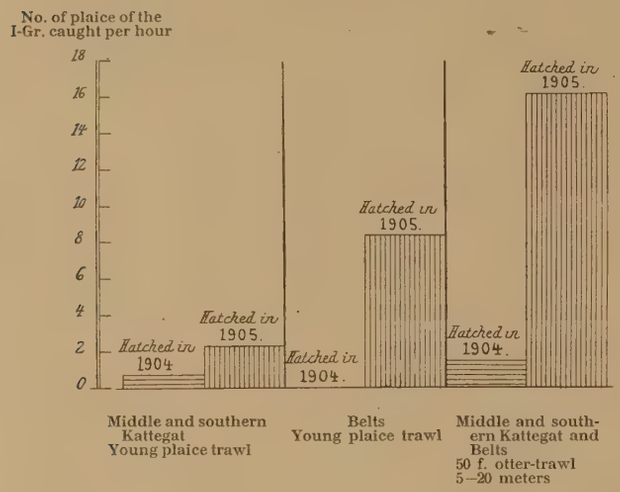

Fig. 7. Graphic representation of the average catch of plaice of the I-Gr. per station and per hour.

I-Gr. 1905 (hatched in 1904) caught in September—Nov. 1905.
I-Gr. 1906 (hatched in 1905) caught in Octbr. 1905 and March, 1906.

Concerning the number of stations in the different waters see Table 1 and Fig. 5, and Fig. 10 C and D.

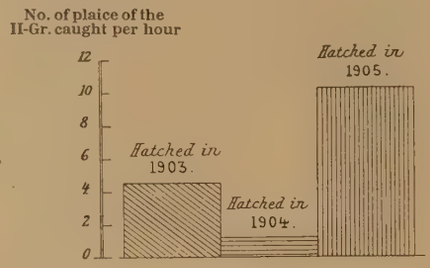

Fig. 8. Graphic representation of the average catch of plaice of the II-Gr. per station and per hour in the middle and southern Kattegat. 50 f. otter-trawl. 5—40 meters.

II-Gr. 1905 (hatched in 1903) caught in Septbr.—Nov. 1905.
II-Gr. 1906 (hatched in 1904) caught in October 1906.
II-Gr. 1907 (hatched in 1905) caught in April—May 1907.

Concerning the number of stations in the different waters see Table 1 and Fig. 11.

If we regard the result of the total age determinations of plaice in the southern Kattegat, the Belt Sea and the Baltic in 1905, 1906 and 1907 from the stations where the age of all the captured specimens has been determined, we obtain the following general view.

Hatched in	1906	— 1722	specimens
—	1905	— 1157	—
—	1904	— 187	—
—	1903	— 364	—

This survey suggests also that the year 1904 has only given a proportionately slight contingent to the increase of the stock of plaice in these waters.

B. The pelagic stages of plaice.

The results of the "Thor"s fishing by Dr. PETERSEN's Young fish trawl after the pelagic stages of the plaice, suggest that these have been very sparsely represented in the Kattegat in 1904 compared with the two or three following years. It will thus be seen from Table 5 (p. 26) that not a single plaice of the pelagic stage was caught in the Kattegat in March 1904, though the amount of fishing was rather considerable. On the other hand not a few specimens were captured in March 1905 and numerous specimens in March 1906. Also in April and May 1907 several pelagic plaice were caught in the Kattegat. It will thus be seen that the same movement in the frequency

which has occurred so plainly with regard to the bottom stages of the series hatched in 1904, 1905 and 1906, already can be traced with regard to the pelagic stages.

Otterstrøm caught in 1904 the following number of pelagic young plaice by Petersen's Young fish trawl in Danish waters[1]:

Month of fishing	Northern Kattegat		Middle and southern Kattegat		Sound		Great Belt		Little Belt		Western Baltic		True Baltic	
	No. of Plaice	Duration of fishing, minutes	No. of Plaice	Duration of fishing, minutes	No. of Plaice	Duration of fishing, minutes	No. of Plaice	Duration of fishing, minutes	No. of Plaice	Duration of fishing, minutes	No. of Plaice	Duration of fishing, minutes	No. of Plaice	Duration of fishing, minutes
March	..	..	..	..	..	..	2	42	..	..	1	90	0	85
April	16	160	0	30	..	..	0	50	..	..	..	..	..	..
May	0	40	1	130	..	..	10	275	5	20	103	170	..	..
June	0	175	1	70	0	30	0	115	0	160	2	130	0	120

It will be seen that the captures in the western Baltic were considerably greater than in the southern Kattegat, the Sound and the Belts. This is again perfectly in accordance with the fact that Duncker found the bottom stages of the 0-Gr. in Neustädter Bay, in the western Baltic, in far greater numbers than we have found the bottom stages in any place off the coasts of the middle and southern Kattegat, the Sound and the Belts (Fig. 3 B p. 19).

It seems as if we might be able to elucidate how far it is a favourable or unfavourable year for the occurrence of the young plaice in these waters, solely by means of a proportionately quickly undertaken investigation concerning the frequency of the pelagic stages in the right season.

In 1904 proportionately more pelagic plaice larvæ were caught in the Kattegat in April than in March and May, and in the Belt Sea proportionately more were caught in May than in March and April. In 1906 an especially great number of larvæ were caught in the Kattegat in March, but they were not fished for in other months.

Concerning Table 5 (p. 26) the following should be remarked:

An asterisk by the figure indicating the number of plaice, means that the determination is not absolutely certain. *Pleuronectes flesus* is supposed to be excluded continuously, but it has not always been possible with certainty to distinguish between *Pl. limanda* and *Pl. platessa*.

The term "near surface" means 0—3 m.

— "intermediate" — between bottom and surface, but deeper than 3 m.

— "bathypelagic" — depths of more than 200 meters.

When the "depth of fishing" is stated by a certain figure, this figure indicates the length of a line which reaches from the head line to a buoy floating on the surface of the water. Experience has shown that if the question is about depths of less than ca. 100 m, the trawl reaches practically quite down to the depth which is indicated by the length of the buoy line.

[1] Report XIII of the Danish Biological Station. 1906.

Table 5. Table showing the capture of the pelagic stages of plaice in Danish waters in the spring months of 1903—1907.
Fishing-apparatus: PETERSEN's Young fish trawl.

Station No.	Date	Place	Central Position N	Central Position E	Depth	Temperature & Salinity, surf. °C.	Temperature & Salinity, surf. ‰	Temp. & Salinity on bottom or intermediate m.	Temp. & Salinity on bottom or intermediate °C.	Temp. & Salinity on bottom or intermediate ‰	Depth of fishing	Duration of fishing	No. of Pleuronectes platessa 5—9 mm.	10—12 mm.	13—15 mm.
			N	E	m.	°C.	‰	m.	°C.	‰	meters	hours			
	February	**The Kattegat.**													
181	1905 Febr. 16	N of Gilleleje.	56° 9′	12°18′	14	1°6	22·3	..	..	..	near surface	1/4	..	..	..
182	» » 16	NW of Nakkehoved.	56°20′,5	12°11′,5	32	1°4	22·4	..	..	..	near surface	1/4	..	..	..
183	» » 16	S of Store Middelgrund.	56°24′	12° 9′	30	1°0	22·4	..	..	..	near surface	1/4	..	..	
184	» » 17	Herthas Flak.	57°39′	10°56′	30	1°3	23·2	..	..	..	near surface	1/4	..	..	..
	March														
27	1903 March 12	NE of Læsø.	57°23′	11°30′	70	2°6	23·4	70	3°9	33·8	intermediate	1/4	..	..	..
28	» » 12	N of Anholt.	56°47′	11°48′	50	2°7	27·3	40	3°1	32·5	intermediate	1/6	..	..	..
29	» » 13	Off Kronborg.	56°02′	12°38′	38	2°3	9·6	35	3°3	31·3	?	?	..	..	..
31	» » 20	N of Anholt.	56°47′	11°49′	c. 40	3°0	18·2	40	3°3	32·8	intermediate	1/3	..	..	..
32	» » 20	E of Læsø.	57°15′	11°22′	66	3°0	19 5	60	3°8	33·6	intermediate	1/4	..	..	..
206 C	1904 March 5	Læsø Rende.	57°15′	10°43′	17	..	..	17	1°0	23·7	intermediate	1/4	..	..	..
216	» » 14	Aalbæk Bay.	57°35′,5	10°33′	12	0°1	24·9	..	..	..	intermediate	1	..	..	..
217	» » 14	Herthas Flak.	57°31′	10°38′	22	0°5	..	..	..	..	intermediate	1/2	..	..	..
219	» » 16	ESE of Skagen L. V.	57°46′	10°46′	38	..	..	..	..	..	intermediate	1/2	..	..	..
227	» » 21	Aalbæk Bay.	57°35′	10°35′,5	15	3°0	29·4	..	..	..	near surface	1/3	..	..	..
228	» » 22	W of Trindelen	57°25′,5	11° 9′,5	11	1°5	22·3	..	..	..	near surface	1/3	..	..	..
229	» » 22	E of Læsø.	57°16′	11°20′	66	1°4	20·3	..	..	..	intermediate	2/3	..	..	..
230	» » 22	Off Kobbergrunden.	57° 8′	11°25′	40–85	1°2	20·8	..	..	..	intermediate	?	..	..	..
232	» » 23	Aalborg Bight.	56°50′,5	10°36′	12	1°9	22·4	..	..	..	intermediate	2/3	..	..	..
233	» » 23	NE of Hals.	57° 3′	10°37′	11	1°9	20·6	..	..	..	intermediate	2/3	..	..	..
234	» » 23	Læsø Rende.	57°13′	10°43′	20	2°0	19·7	20	6°3	28·1	intermediate	2	..	..	..
235	» » 24	ENE of Trindelen.	57°28′	11°28′	57	1°7	20·0	..	..	..	intermediate	2/3	..	..	..
236	» » 24	NW of Fladen L. V.	57°12′	11°44′	28	1°8	20·5	..	..	..	intermediate	2/3	..	..	..
237	» » 24	N of Anholt.	56°57′	11°32′	13	1°7	18·8	..	..	..	intermediate	1/2	..	..	..
239	» » 25	W of Anholt.	56°43′	11°26′	7—8	1°6	19·4	..	..	..	intermediate	1 5/6	..	..	..
240	» » 26	Off Kullen.	56°17′	12°24′	25	2°4	15·4	..	..	..	near surface	1/3	..	..	..
»	» » »	» »	»	»	..	..	..	25	4°9	32·8	intermediate	1/3	..	..	..
342	1905 March 16	N of Anholt.	56°49′	11°40′	21	2°5	16·8	..	..	..	near surface	1	..	..	..
»	» » »	» »	»	»	..	..	..	21	5°0	22·1	on bottom	1/2	1*	..	..
347	» » 17	SW of Anholt.	56°36′	11°29′	25	2°6	16·3	25	4°5	17·0	near surface	1	..	..	..
348	» »17&18	Læsø Rende.	57°23′	11°45′	26	2°8	22·1	26	3°5	33 9	intermediate	8	..	..	..
356	» » 27	SE of Trindelen.	57°24′	11°27′	60	2°8	15·9	60	4°0	34·9	30—40 m	1	..	..	..
359	» »29&30	Aalbæk Bay	57°34′	10°35′	16	3°4	31·6	..	..	..	intermediate	2	2*	..	..
»	» » 30	» »	»	»	..	..	..	16	3°5	33·2	on bottom	2	6*	1*	..
»	» » »	» »	»	»	..	..	..	.	..	..	intermediate	2	..	1*	..
361	» » 31	Aalborg Bay.	56°48′	10°35′	9	3°3	23·4	9	4°0	26·2	intermediate	5	..	..	..
716	1906 March 1	The Sound.	55°55′	12°37′	12	1°5	17 1	12	2°8	24·5	intermediate	1	4*	..	..
717	» » 2	» »	55°55′	12°37′	12	1°5	19·5	12	2°8	24·5	intermediate	1	..	..	..
719	» » 2	» »	55°56′	12°35′	11	1°5	19·0	11	1°5	19·0	intermediate	6	2	2	..
721	» » 3	» »	55°57′	12°37′	18	1°6	19·8	18	4°7	30·5	intermediate	4	6*	..	..
728	» » 7	N of Sealand's Odde.	56°00′	11°23′	17	1°9	19·2	..	..	..	near surface	1	..	..	..
»	» » »	» »	»	»	..	..	..	17	5°1	31·7	on bottom	1	38	1	..
730	» » 7&8	Off Hjelm.	56°11′	10°59′	21	2°3	20·8	10	2°3	21·1	intermediate	9	40	3	..
734	» » 11	SE of Fornæs.	56°19′	11°11′	22	2°0	21·3	22	3°7	30·3	ca. 20 m.	1	20	4	..
738	» » 14	S of Anholt.	57°41′	11°36′	17–23	2°1	25·7	17–23	2°9	29·7	intermediate	6	39	3	..
741	» » 19	E of Skagen L. V.	57°48′	11°13′	65	2°9	32·4	..	..	..	near surface	3	3*	..	..
»	» » »	» »	»	»	..	..	..	20	3°1	33·1	ca. 20 m.	3	4*	..	..
»	» » »	» »	»	»	..	..	..	40	3°3	33·4	ca. 45 m.	1	..	..	..
»	» » »	» »	»	»	..	..	..	65	3°8	34·4	ca. 65 m.	1	..	..	..

Table 5. Continued.

Station No.	Date	Place	Central Position N	Central Position E	Depth m.	Temperature & Salinity, surf. °C.	Temperature & Salinity, surf. ‰	Temp. & Salinity on bottom or intermediate m.	Temp. & Salinity on bottom or intermediate °C.	Temp. & Salinity on bottom or intermediate ‰	Depth of fishing meters	Duration of fishing hours	Pleuronectes platessa 5—9 mm.	Pleuronectes platessa 10—12 mm.	Pleuronectes platessa 13—15 mm.
	March	**The Kattegat.**													
745	1906 March 20	Hertha's Flak.	57°38′	10°43′	28	2°8	32·6	10	2°8	32.7	ca. 10 m.	1	..	..	..
750	» » 22	S of Trindelen.	57°23′	11°16′	25—35	1°8	26·4	35	3°2	32·4	near surface	2	10	1	..
764	» » 27	Aalborg Bay.	56°54′	10°35′	8	1°4	24·9	8	1°5	25·0	near surface	3	12	1	..
»	» » 28	» »	»	»	»	1°7	24·8	..	1°7	24·9	near surface	3	5*	..	..
769	» » 30	Hertha's Flak.	57°33′	10°43′	28	2°1	23·9	28	3°3	31·5	near surface	1	..	..	..
	April														
362	1905 April 1	Aalborg Bay.	56°50′	10°24′	6	4°2	..	6	4°6	.	intermediate	2	..	..	..
364	» » 4	SSW of Kobbergrunden L. V.	57°03′	11°21′	9	3°3	16·7	9	3°5	16·8	near surface	1/2	..	..	..
366	» » 7	SW of Marstrand.	57°44′	11°15′	50	2°7	26·1	50	4°7	34 0	ca. 52 m.	1/2	3	..	..
923	1907 April 2	The Sound.	55°57′	12°37′	15	3°1	8·5	15	4°1	9·2	near surface	1	..	..	..
924	» » 2	Off Kullen.	56°14′	12°19′	26	3°8	21·7	26	4°1	28·1	near surface	1	..	..	..
926	» » 2	Southern Kattegat.	56°23′	11°54′,—	32—26	4°0	10·5	..	..	..	near surface	4	1*	..	..
			56°24′	11°45′	..	..	..	..	..	..	....	..	..	..	..
927	» » 3	Southern Kattegat.	56°24′	11°29′,—	23	3°5	20·4	23	4°8	24·1	near surface	4	..	..	..
			57°25′	11°22′	..	..	..	..	..	..	....	..	..	..	..
931	» » 5	Læsø Rende.	57°21′	10°47′	28	3°9	27·5	28	4°2	33·3	ca. 15 m	3	..	..	..
	May														
1027	1905 May 14	Aalborg Bay.	56°35′	10°31′	8	8°7	25·0	8	6°8	29·1	near surface	1	8	5	..
1028	» » 14	Aalborg Bay.	56°33′	10°40′	8	8°7	28·1	8	6°3	29·8	near surface	1	..	..	..
1031	» » 14	Aalborg Bay.	56°50′	10°44′	11	9°8	24·0	11	5°6	29 1	near surface	1/2	..	..	..
1046	» » 21	N of Læsø.	57°26′	10°54′	26	8°5	22·4	26	5°9	33·3	ca. 15 m.	1	..	3	..
1047	» » 22	Aalbæk Bay.	57°36′	10°27′	7	8°6	22·3	7	6°2	31·9	on bottom	1/4	2	2	..
1048	» » 22	Aalbæk Bay.	57°36′	10°31′	9	8°7	22·3	9	6°0	32 4	on bottom	1/4	1	2	..
1054	» » 22	N of Læsø.	57°25′	11°01′	7	8°8	22·7	7	8°9	22·9	on bottom	1/4	..	1	..
1056	» » 23	Aalbæk Bay.	57°36′	10°38′	19	9°5	21·6	19	7°1	32·3	ca. 10 m.	1	1*	..	..
1057	» » 23	Aalbæk Bay.	57°36′	10°29′	8	9°8	22·1	8	7°2	33·3	on bottom	1/4	2	1	..
1065	» » 24	Aalborg Bay.	56°55′	10°59′	10	10°7	17·0	10	8°0	18·6	ca. 5 m.	1	..	..	..
1066	» » 24	NW of Anholt.	56°52′	11°20′	13	9°9	17·6	13	9°6	17·7	near surface	1	..	..	..
1067	» » 24	N of Anholt.	56°50′	11°42′	24	10°4	16·5	24	5°2	30·5	ca. 5 m.	1	..	..	..
1068	» » 25	E of Læsø.	57°13′	11°23′	64	10°4	18·6	64	5°0	32·1	ca. 5 m.	1	..	..	..
1069	» » 25	NE of Læsø.	57°23′	11°20′	40	10°4	19·9	40	5°7	33·8	ca. 30 m.	1	..	..	..
1071	» » 25	Off Vinga.	57°39′	11°12′	42	10°5	20·1	42	7°0	32·0	ca. 30 m.	1/2	..	..	..
	February	**The Skagerak.**													
185	1904 Febr. 17	WNW of Hirshals.	57°37′	9°45′	30	2°7	34·0	..	..	..	near surface	1/4	..	..	..
186	» » 17	WNW of Hirshals	57°39′	9°26′	36	3°3	34·3	..	..	..	near surface	1/4	..	..	..
187	» » 17	W by N of Hirshals.	57°40′	9°12′	42	3°7	34·5	..	..	..	intermediate	1/4	..	..	..
188	» » 17	Deep Skagerak.	57°46′	8°49′	210	3°3	33·0	..	..	..	near bottom	5/6	..	..	..
190	» » 17	Deep Skagerak.	57°49′,5	8°37′	425	..	..	..	..	..	bathypelagic	1/2	..	..	..
	March														
26	1903 March 11	N of Hirshals.	57°44′	9°56′	70	..	..	..	..	..	intermediate	1/8	..	..	..
213	1904 March 10	Deep Skagerak.	58°18′	10° 8′	470	..	..	..	..	..	bathypelagic	2	..	..	..
220	» » 16	NE of Skagen L. V.	57°49′,5	10°50′	88	0°3	..	..	..	..	intermediate	1/2	..	..	..
221	» » 16	NE of Skagen L. V.	57°52′,5	10°48′	135	1°1	25·9	135	5°4	33·3	near surface	1/2	..	..	..
222	» » 16	NNE of Skagen L. V.	57°55′	10°47′,5	170	0°1	24·6	170	5°6	34·9	intermediate	1/2	..	..	..
224	» » 17	Deep Skagerak.	58°04′	9°55′	244	3°4	32·5	..	..	..	near surface	1/2	..	..	..
349	1905 March 21	Tannis Bay.	57°42′	10°23′	17	3°3	32·2	17	3°5	32·3	intermediate	1	..	..	..
351	» »22&23	Jammer Bay.	57°20′	9°24′	9	2°3	32·1	..	..	..	near surface	4	..	..	..

Table 5. Continued.

Station No.	Date	Place	Central Position N	Central Position E	Depth m.	Temperature & Salinity, surf. °C.	Temperature & Salinity, surf. ‰	Temp. & Salinity, on bottom or intermediate m.	Temp. & Salinity, on bottom or intermediate °C.	Temp. & Salinity, on bottom or intermediate ‰	Depth of fishing meters	Duration of fishing hours	Pleuronectes platessa 5—9 mm.	Pleuronectes platessa 10—12 mm.	Pleuronectes platessa 13—15 mm.
	March	**The Skagerak.**													
751	1906 March 23	NE of Skagen Light.	57°58′	10°50′	140—188	2°6	32·9	..	..	..	near surface	1	..	..	..
»	» » »	» » »	»	»	..	..	..	140	5°0	35·0	ca. 150 m.	2	..	..	..
»	» » »	» » »	»	»	..	..	..	188	5°1	35·0	ca. 150 m.	4	..	..	..
752	» » 23	Deep Skagerak.	58°15′	10°40′	227—289	3°1	32·6	..	..	..	near surface	1	..	..	..
753	» » 23	Deep Skagerak.	58°15′	10°21′	387—400	3°1	32·9	..	..	..	near surface	1	..	..	..
»	» » »	» »	»	»	..	..	..	300	5°6	35·2	bathypelagic	1	..	..	..
754	» » 23	Deep Skagerak.	58°15′	10°09′	550	3°5	33·1	500	5°3	34·9	near surface	2	..	..	..
757	» » 24	N by W of Skagen Light.	58°03′	10°21′	190—105	3°5	33·4	105	6°1	35·1	near surface	1	1*	..	..
758	» » 24	N of Skagen Light.	57°56′	10°32′	97	3°7	33·8	..	..	..	near surface	1	..	..	..
759	» » 24	N of Skagen Light.	57°47′	10°38′	85	2°5	31·5	..	..	..	near surface	1	..	..	..
770	» » 30	Tannis Bay.	57°37′	10°09′	13	2°6	30·2	..	..	..	near surface	3	3	..	..
»	» » »	» »	»	»	..	..	..	13	4°1	33·1	ca. 9 m.	3	2	..	..
	April														
50	1903 April 17	W of Hirshals.	57°35′	9°34′	30	6°1	33·8	30	5°7	34·8	intermediate	½	3	2	..
369	1905 April 8	Deep Skagerak.	58°05′	9°36′	414	3°9	32·3	..	..	..	near surface	2	..	..	..
»	» » »	» »	»	»	..	..	..	414	2°4	35·0	ca. 100 m.	2	..	..	..
782	1906 April 3	NW of Hirshals.	57°49′	9°22′	105	4°3	..	..	..	..	?	½	..	..	..
»	» » »	» »	»	»	..	..	..	105	5°6	..	?	1	..	..	..
783	» » 3&4	Deep Skagerak.	57°57′	8°50′	510	3°5	..	510	5°7	..	ca. 75 m.	1	..	..	..
784	» » 4	E by S of Oxö Light.	58°05′	8°21′	108	3°2	33·4	108	5°3	34·9	near surface	1	1	..	..
785	» » 4	Deep Skagerak.	57°47′	8°21′	425	3°9	33·5	425	5°7	35·2	near surface	1	..	..	..
787	» » 4	NW of Hanstholm.	57°11′	8°21′	25	5°0	35·0	..	..	..	near surface	1	..	..	..
»	» » »	» »	»	»	..	..	..	25	4°6	34·9	ca. 15 m.	1	1*	..	..
938	1907 April 9	Deep Skagerak.	56°52′	8°44′	550—570	4°1	32·5	..	..	..	near surface	1	..	..	..
»	» » »	» »	»	»	..	..	..	550-570	5°7	35·1	bathypelagic	3	..	..	..
939	» » 11	Deep Skagerak.	58°08′	9°34′	ca. 500-600	4°4	32·9	..	..	..	near surface	1	.	..	.
»	» » »	» »	»	»	..	..	..	195	5°8	35·0	bathypelagic	2	..	..	..
»	» » 12	» »	»	»	..	..	..	..	..	..	....	6	..	..	..
940	» » 12	Deep Skagerak.	58°03′	9°49′	220	4°4	32·7	220	5°8	34·9	near surface	1	..	..	..
949	» » 15	NE of Hirshals.	57°39′	10°05′	16	5°0	34·9	16	5°8	35·0	near surface	1	..	..	..
950	» » 16	Jammer Bay.	57°18′	9°15′	17	5°2	34·3	17	4°8	34·3	near surface	2	1*	..	..
955	» » 16	NE of Hanstholm.	57°22′	8°46′	28	5°3	34·3	28	5°4	24·9	near surface	3	..	1*	..
	May														
1018	1907 May 11	NW of Rubjerg.	57°32′	9°34′	24	7°4	33·5	24	6°6	33·7	ca. 18 m.	1	3	3	.
1032	» » 15	Tannis Bay.	57°41′	10°23′	9	9°5	33·5	9	9°5	33·5	on bottom	½	..	1	.
1034	» » 15	Tannis Bay.	57°40′	10°20′	13—15	9°4	33·4	13—15	9°4	33·4	on bottom	½	..	6	..
1035	» » 15	Tannis Bay.	57°41′	10°19′	18—22	8°8	33·4	18—22	8°6	33·4	on bottom	½	..	1*	
1039	» » 16	Deep Skagerak.	58°18′	10°07′	450	8°7	31·0	..	..	..	near surface	1	..	..	..
»	» » »	» »	»	»	..	..	..	450	5°1	34·9	bathypelagic	2	..	..	.
1040	» » 16	Deep Skagerak.	58°08′	10°35′	ca. 220	8°0	34·0	..	..	..	near surface	1	..	..	..
1041	» » 16	WSW of Måseskär	57°57′	11°02′	120	8°6	26·0	120	5°6	34·5	near surface	1	..	..	..
1073	» » 28	NW of Hirshals	57°47′	9°17′	96	9°4	31·6	96	5°9	34·9	near surface	1	..	..	.
1074	» » 28	Deep Skagerak.	57°47′	8°10′	510	8°7	28·3	..	..	..	ca. 10 m.	1	..	..	..
»	» » »	» »	»	»	..	..	..	510	5°1	34·1	bathypelagic	2	..	..	..
1076	» » 30	Deep Skagerak.	57°47′	7°39′	490	8°5	28·1	..	..	..	ca. 10 m.	1	..	..	..
»	» » »	» »	»	»	..	..	..	490	5°5	34·7	bathypelagic	3	..	..	..
	June														
1080	1907 June 1	NW of Hanstholm.	57°29′	8°12′	120	7°6	31·1	120	6°1	35·1	ca. 30 m.	1	..	..	..

Table 5. Continued.

Station No.	Date	Place	Central Position N	Central Position E	Depth m.	Temperature & Salinity, surf. °C.	Temperature & Salinity, surf. ‰	Temp. & Salinity on bottom or intermediate m.	Temp. & Salinity on bottom or intermediate °C.	Temp. & Salinity on bottom or intermediate ‰	Depth of fishing meters	Duration of fishing hours	Pleuronectes platessa 5–9 mm.	Pleuronectes platessa 10–12 mm.	Pleuronectes platessa 13–15 mm.
	February	**The North Sea.**													
202B	1904 Febr. 26	SW of Graadeep.	55°19′	8° 8′	14	1°7	..	..	..	..	near surface	1/3	..	..	..
203B	» » 26	SW of Graadeep.	55°21′,5	8°10′,5	13	1°5	31·1	..	..	..	near surface	1/4	..	..	..
	March														
352	1905 March 23	WNW of Hanstholm.	57°14′	7°43′	50	4°9	35·0	50	5°0	35·1	intermediate	6	5	1	.
353	» » 24	Off Lodbjerg.	56°49′	8°12′	17	3°6	32·1	17	4°0	34·0	intermediate	8	..	..	..
	April														
46	1903 April 16	Off Husby.	56°10′	7°59′	19	5°9	..	..	..	..	intermediate	1/4	1	4	1
47	» » 16	Off Torup.	57°00′	8°19′	19	5°4	..	..	..	..	intermediate	1/3	11	2	..
372	1905 April 9	Jutland Bank.	56°35′	7°35′	27	4°8	34·7	27	5°3	34·7	near surface	1/2	10*	..	..
373	» » 9	N of Horns Reef LV.	55°44′	7°13′	27	4°5	33·5	27	4°8	33·6	intermediate	2	4*	.	..
377	» » 13	Off Tyborøn.	56°41′	8°08′	17	3°8	32·3	17	3°9	32·3	intermediate	2	..	..	..
380	» » 14	Tail End of Doggerbank.	55°33′	4°39′	32	5°5	34·8	..	..	..	near surface	2	ca. 7	ca. 3	..
»	» » »	» »	»	»	..	..	..	32	5°5	34·8	ca. 25 m.	3	16	9	..
382	» » 15	North End of Slugen.	55°36′	7°50′	15	4°2	31·1	15	4°5	31·3	intermediate	1/2	..	..	..
788	1906 April 4	Off Tyborøn Bn.	56°42′	8°08′	15	4°7	33·8	15	3°5	34·7	near surface	1	3*	..	..
789	» » 5	Jutland Bank.	56°40′	7°29′	31	4°5	34·8	31	5°0	35·0	near surface	1	..	..	.
791	» » 5	S of Little Fisher Bank.	56°20′	7°00′	37	4°2	34·4	37	4°5	34·6	ca. 15 m.	1	2*	..	..
792	» » 5	S of Little Fisher Bank.	56°06′	6°58′	36	4°2	34·3	36	3°8	34·4	ca. 15 m.	1	3	..	..
793	» » 5 & 6	Horns Reef Rising Ground.	55°52′	6°56′	37	..	..	37	3°7	34·8	ca. 15 m.	1	84*	..	
»	» » »	» »	»	»	»	4°0	34 5	..	..	..	near surface	1	15*	..	
794	» » 6	Horns Reef Outer Ground.	55°42′	6°19′	47	4°5	34·8	..	..	..	near surface	1	..	..	.
»	» » »	» »	»	»	..	..	..	47	3°9	34·8	on bottom	1	8*	..	..
795	» » 6	Horns Reef Rising Ground.	55°37′	6°46′	38	4°1	34·1	38	3°8	34 8	ca. 43 m.	2	76	..	..
796	» » 7	Horns Reef Area.	55°32′	7°15′	28	3°6	33·5	28	3°6	33·5	ca 20 m.	2	32*	..	.
798	» » 7	Horns Reef Area.	55°24′	7°43′	20	3°9	33·5	20	3°8	33·4	near surface	1	3*	..	..
802	» » 9	Horns Reef Area.	55°42′	8°04′	15	4°1	33·6	15	5°8	33·7	ca. 10 m.	1	8	..	.
803	» » 9	Horns Reef Area.	55°53′	7°51′	24	4°7	33·7	24	3°9	33·9	ca. 10 m.	1	25*	..	..
804	» » 9 & 10	Off Søndervig.	56°03′	7°38′	30	4°4	34·2	30	3°9	34·4	ca. 10 m.	2	30	3	.
806	» » 10	S by E of Blaavand Point.	55°29′	8°09′	9	4°9	33·8	9	4°4	33·7	near surface	1	7	1	.
956	1907 April 17	Off Thyborøn.	56°46′	8°09′ to	19	5°5	32·6	19	5°6	33·6	near surface	3	67	4	1
			56°42′	8°07′	..	..	..	..	..	..	....	..	..	..	..
960	» » 18	S by W of Blaavand Point.	55°27′	8°05′	16	5°5	31·5	16	5°6	31·5	near surface	1	3*	..	..
982	» » 29	N of Horns Reef.	55°39′	7°30′	15	5°4	32·8	15	5°9	32·8	near surface	3	39	5	..
983	» » 30	N of Horns Reef.	55°39′	7°30′	17	5°9	32·8	17	5°8	32·8	ca. 15 m.	3	90	36	..
	May														
989	1907 May 1	Horns Reef Outer Ground.	55°15′	6°08′	45	6°4	34·7	..	..	..	near surface	1	..	..	..
»	» » 1	» »	»	»	..	..	..	45	5°9	34·7	ca. 30 m.	1	9	..	..
991	» » 2	Horns Reef Rising Ground.	56°15′	6°53′	30-34	5°7	33·7	30-34	5°6	33·7	ca. 28 m.	1	40	28	
1013	» » 10	S of Little Fisher Bank.	56°05′	6°48′	40	6°4	34·3	40	5°9	34·3	ca. 28 m.	1	ca. 180	32	
1017	» » 10	Little Fisher Bank.	56°37′	7°00′	37	6°4	34·6	37	5°8	34·6	ca. 28 m.	1	4	3	.
1075	» » 29	SSW of Lindesnæs.	57°47′	7°00′	375	..	..	..	..	..	bathypelagic	4	..	..	..
1077	» » 31	N of Little Fisher Bank.	57°32′	7°00′	210	8°5	29·9	210	5°9	35·1	near surface	1	..	..	..
1078	» » 31	N of Little Fisher Bank	57°11′	7°00′	56	9°7	32·3	56	6°9	35·0	near surface	1	..	..	.
1079	» » 31	N of Little Fisher Bank.	57°19′	7°34′	50	8°1	30·6	30	5°9	35·1	ca. 30 m.	1	..	..	.

IV. Variation in the frequency of young plaice in the North Sea and Skagerak off the west coast of Jutland and in the northern Kattegat from 1902—1906.

A. The bottom stages of plaice.

Off the west coast of Jutland no coast investigations have been undertaken concerning the frequency of plaice fry during several subsequent years as was the case in the waters east of the Skagen. Only one single systematic coast investigation has been accomplished, namely in the summer and autumn of 1905, from June 26th till November 7th. In this investigation a fine-meshed Young plaice trawl was used in preference, and the fishing was carried on in the places where the 0-Gr. of the plaice was most numerously represented. The trawl was thus usually employed at depths between 0·5 and 6 meters and always in calm weather.

The result of this investigation in 1905 is with regard to the 0-Gr. represented on Fig. 4 and with regard to the I-Gr. on Fig. 5; while the detailed review concerning the position of the stations and the duration of the hauls etc. is given in Table 1 (p. 7).

It will be seen in Fig. 4 that numerous specimens of the 0-Gr. have been caught along the greater part of the west coast of Jutland. It is, however, plain that considerably fewer specimens have been caught on the stretch from Thyborøn to south of Nymindegab than on the other stretches. Jammer Bay as well as the stretch Blaavandshuk—Fanø are distinguished by a very great number of specimens.

If we compare the stations off the west coast of Jutland with the stations in the Belt Sea and the Baltic, it will be seen that there is a decrease in the captures of specimens in the waters towards the Baltic. The captures have been greatest in the North Sea and the Skagerak, less in the Kattegat, still less in the Belt Sea and least off the coasts of the Baltic. It should be remembered, however, first, that the coast stretches of our inshore waters are very extensive in proportion to the size of the waters, and secondly, that the 0-Gr. has not its home off the coasts of the Baltic from 0—6 meters' depth, but in somewhat deeper water from ca. 10—40 meters. (See Fig. 9 D.)

If we study the distribution of the I-Gr. (or the specimens hatched in 1904) on Fig. 5, we also get the impression of a considerable richness of specimens on great stretches off the west coast of Jutland, thus especially in the Skagerak and in the inshore waters at Thyborøn and Esbjerg. Off the west coast of Jutland between Thyborøn and Nymindegab we again find a stretch with only a scanty population.

In 1906 our coast investigations did not extend further west than to Hirshals. We employed the Young plaice trawl from motor-boat as in 1905, and the investigations took place in the month of October. Also in 1906 numerous specimens, both of the 0 and I-Gr., were caught between Skagen and Hirshals, however not so many as in 1905 (see Fig. 4 and 5). For the northern Kattegat the capture of the 0-Gr. was greater in 1906 than in 1905, while the I-Gr. was about equally represented in the two years.

In 1907 the coast investigations were carried on partly in April—June, partly in August, thus mainly in an earlier season than in the two preceding years. For this reason it is already difficult to make a direct comparison between the capture of specimens in 1907 and the capture in the two preceding years. A comparison of this kind can only be partially justified with regard to the specimens caught in August. It will be seen from Figs. 4 and 5 that the capture of specimens of the 0-Gr. and I-Gr. in the northern Kattegat was greater than in the two preceding years. As stated on p. 5 the apparatus employed in 1907 was also somewhat larger than that employed during the two preceding years.

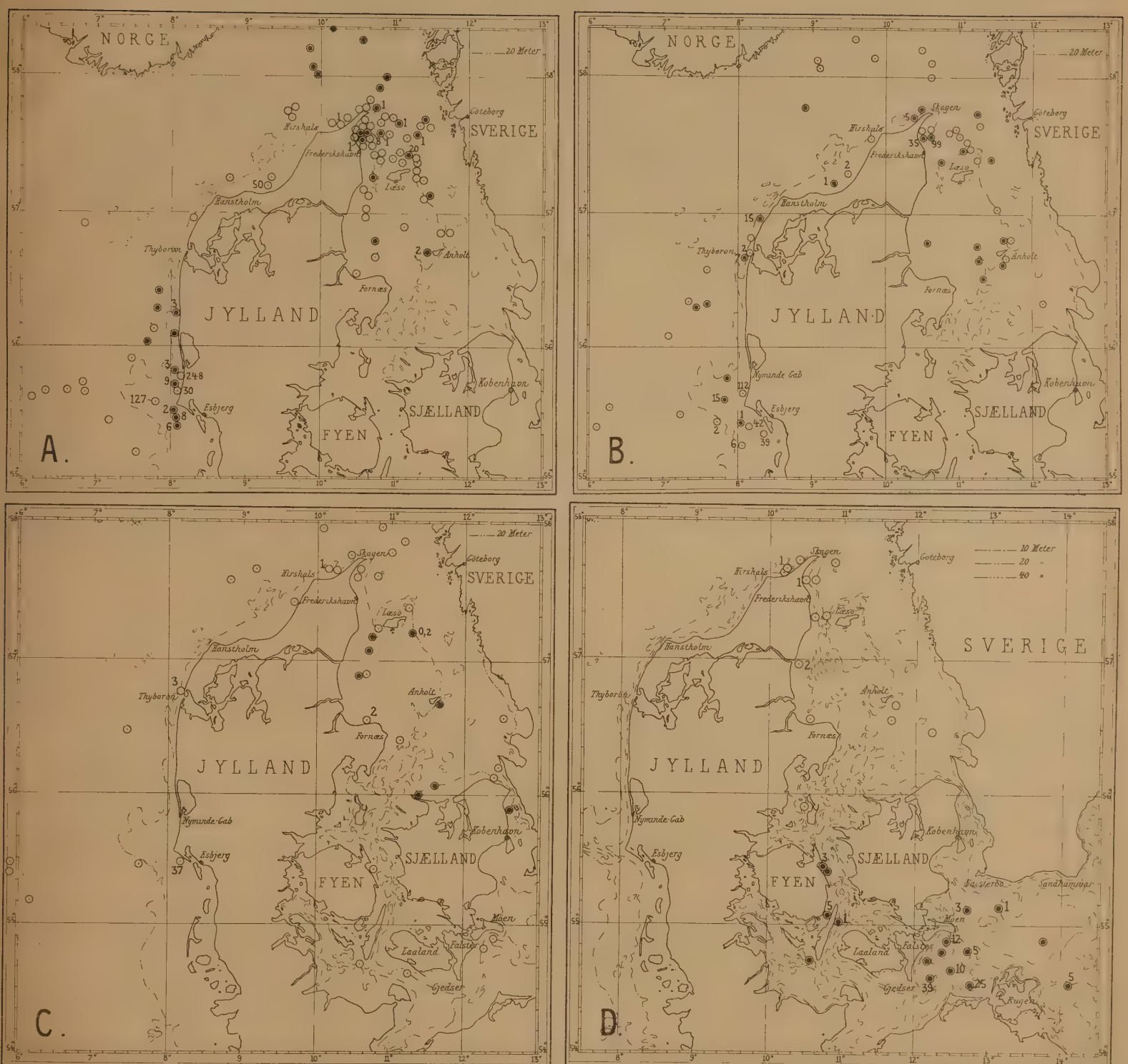

Fig. 9. No. of plaice of the 0-Gr. caught per hour by 50 feet otter-trawl. (If no figure, no capture of the 0-Gr.)

A. 0-Gr. 1903. ⊙ September—November 1903. ◉ February—March 1904.
B. 0-Gr. 1904. ⊙ September - October 1904. ◉ March—April 1905.
C. 0-Gr. 1905. ⊙ September—November 1905. ◉ March 1906.
D. 0-Gr. 1906. ⊙ October 1906. ◉ March 1907.

In the coast investigations by Young fish trawl in the months July—March we catch normally considerably more specimens of the 0-Gr. than of the I-Gr. at depths of 0—ca. 3 m. With regard to Tannis Bay and Aalbæk Bay the reverse has been the case in the two years during which the investigations have been carried on: 1905 and 1906. This feature may probably be accounted for in the way that great migrations of year-old fry take place from Jammer Bay to Tannis Bay and from Tannis Bay to Aalbæk Bay. The counting of fin rays has proved that the proportionately large stock of the I-Gr. in Aalbæk Bay cannot have immigrated from the southern parts of the Kattegat, which also on account of the slight frequency of the 0-Gr. and I-Gr. here would be improbable (Comp. A. C. JOHANSEN: Ueber die Schollenfischerei etc. 1906, p. 82—83). That an immigration of young plaice of ca. 18—30 cm. (mainly of the II-Gr.) takes place on a large scale from the Skagerak to the northern Kattegat has been proved by the Danish marking experiments. The migration of the young plaice should go here in the same direction as is normal for the current.

Whilst the coast investigations off the west coast of Jutland have not increased our knowledge much concerning the variation in the frequency of young plaice in the different years, because the investigations for the greater part were only carried on for one single year, the trawlings furnish us on the other hand with important information in this respect.

On Figs. 9, 10, 11 and 12 it has been charted how many specimens, respectively of the 0-Gr., I-Gr, II-Gr. and III-Gr. have been caught in hauls by 50 feet otter-trawl per hour at the different stations. With regard to the I-Gr. we have no determinations at hand for the specimens hatched in 1902 and 1903. As an equivalent for the I-Gr. in autumn and winter, thus, for the specimens of an age of about 2 years, the captures of the specimens from 10—19 cm. have been represented on Fig. 10 A and B. For the northern Kattegat and Skagerak the group of a length of 10—19 cm., is in the main identical with the I-Gr. in autumn and winter. For the Horns Reef area the group of 10—19 cm. comprises besides the I-Gr. also a considerable number of specimens of the II-Gr. (comp. A. C. JOHANSEN: Contributions I 1905 and l. c. 1906).

Table 1 and the Figs. 9, 10, 11 and 12 show with great distinctness that the annual series from 1902 and 1903 occurred in great abundance in the Horns Reef area, but were not particularly frequent in the Skagerak and the northern Kattegat.

We observe the series from 1902 for the first time as I-Gr. in the autumn of 1903 and February—March of 1904 (Fig. 10 A). Next time we see it as III-Gr. in the autumn of 1905 (Fig. 12 A). On both Figs. it will be seen that the number of specimens in the Horns Reef area dominates completely the number of specimens in the Skagerak and the northern Kattegat[1].

The series from 1903 we observe for the first time as 0-Gr. in the autumn of 1903 and February—March of 1904 (Fig. 9 A). Afterwards we observe it as I-Gr. in the autumn of 1904, and in the transition stage between I-Gr. and II-Gr. in March—April 1905 (Fig. 10 B). At last we notice it as II-Gr. in the autumn of 1905 (Fig. 11 A). On all these charts, it is a conspicuous feature that the number of specimens in the Horns Reef area by far exceeds the number of specimens in the Skagerak and northern Kattegat.

The series from 1904 we notice as 0-Gr. in the autumn of 1904 and in the transition stage between 0-Gr. and I-Gr. in March and April, 1905 (Fig. 9 B). As I-Gr. we find the series in the autumn of 1905 and in March 1906. Fig. 10 C forms a supplement to Fig. 5 A, indicating the captures of the I-Gr. outside the coast stretches in September—November, 1905, and in March, 1906. By comparison of these Figs. it will be seen that the plaice in the Horns Reef area have spread far more than for instance in Tannis

[1] Even if we compare the number of specimens of 10—14 cm. in the Horns Reef area with the number of specimens of 10—19 cm. in the Skagerak and the northern Kattegat, the first named area has a considerable predominance. (Comp. Fig. 10 A. with Pl. II and III in Contributions I).

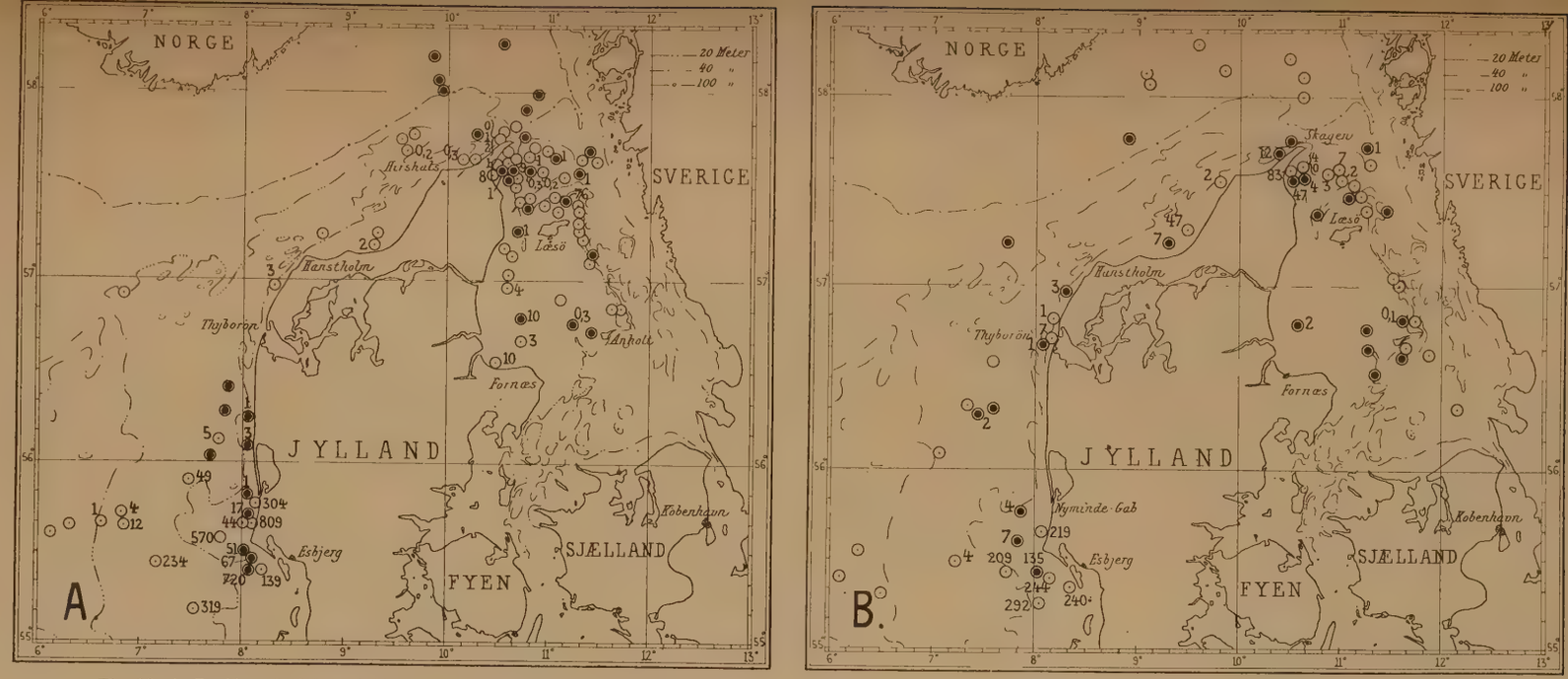

Fig. 10, A, B. No. of plaice of 10—19 cm. length caught per hour by 50 f. otter-trawl.
A. ⊙ September—November, 1903. ◉ February—March, 1904. The main part of these plaice belong to the I-Gr. (A. hatched mainly in 1902, B. hatched mainly in 1903).
B. ⊙ September—October, 1904. ◉ March—April, 1905.

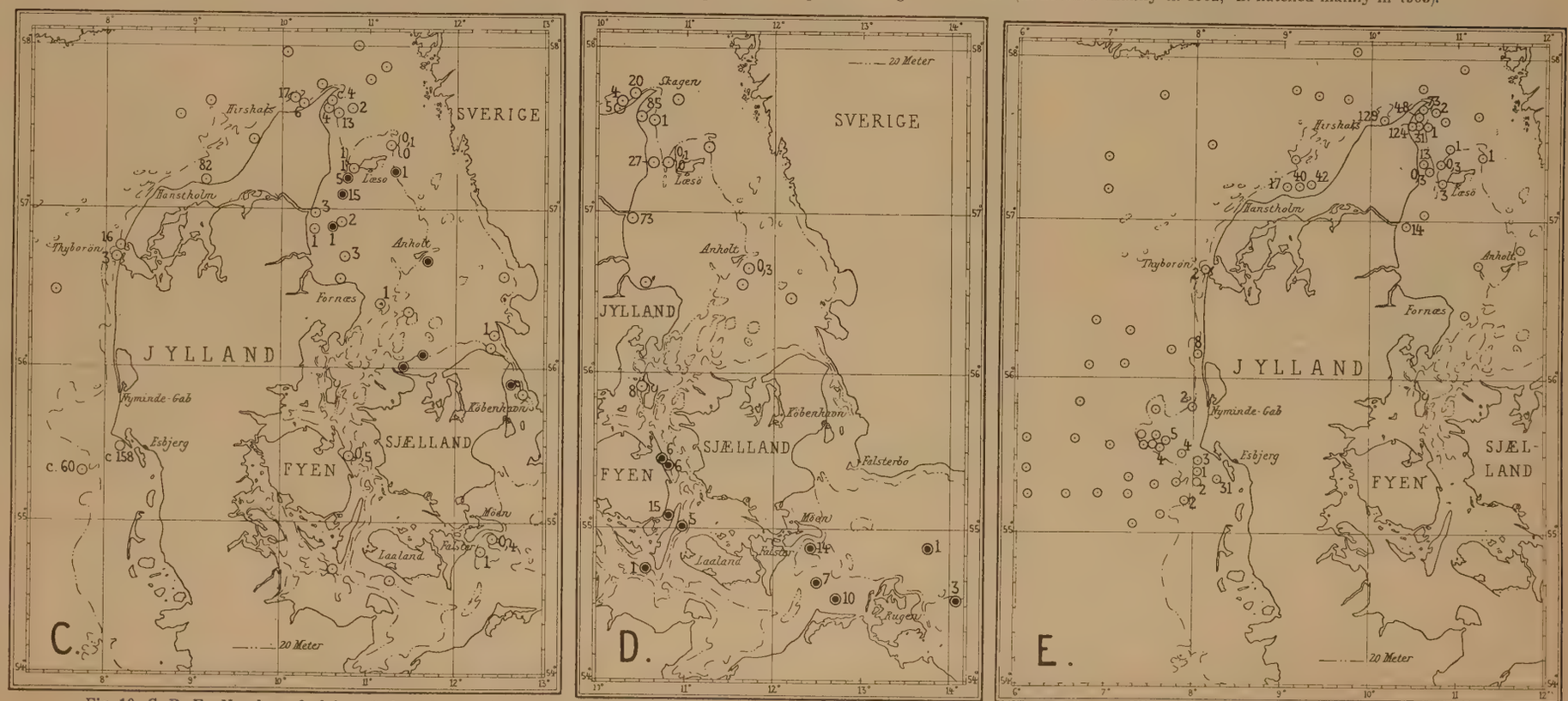

Fig. 10, C, D, E. Number of plaice of the I-Gr. caught per hour by 50 f. otter-trawl.
C. I-Gr. 1905 (hatched in 1904). ⊙ September—November, 1905. ◉ March, 1906.
D. I Gr. 1906 (hatched in 1905). ⊙ October, 1906. ◉ March, 1907.
E. I Gr. 1907 (hatched in 1906). ⊙ April—June, 1907. — If no figure, no capture of the I-Gr.

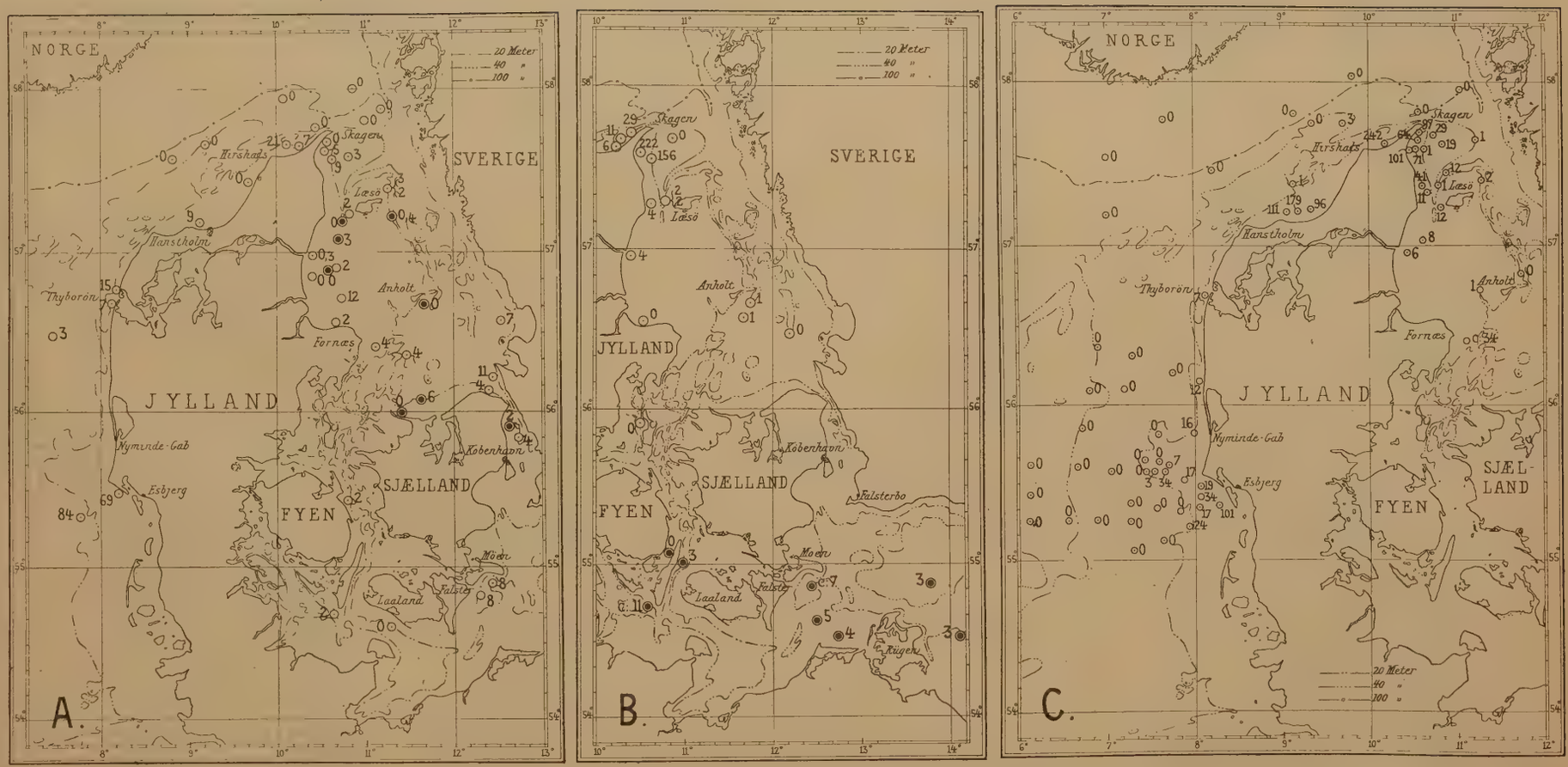

Fig. 11. No. of plaice of the II-Gr. caught per hour by 50 f. otter-trawl.

A. II-Gr. 1905 (hatched in 1903), ⊙ September November 1905. ◉ March 1906.

B. II-Gr. 1906 (hatched in 1904). ⊙ October 1906. ◉ March 1907.

C. II-Gr. 1907 (hatched in 1905). ⊙ April—June 1907.

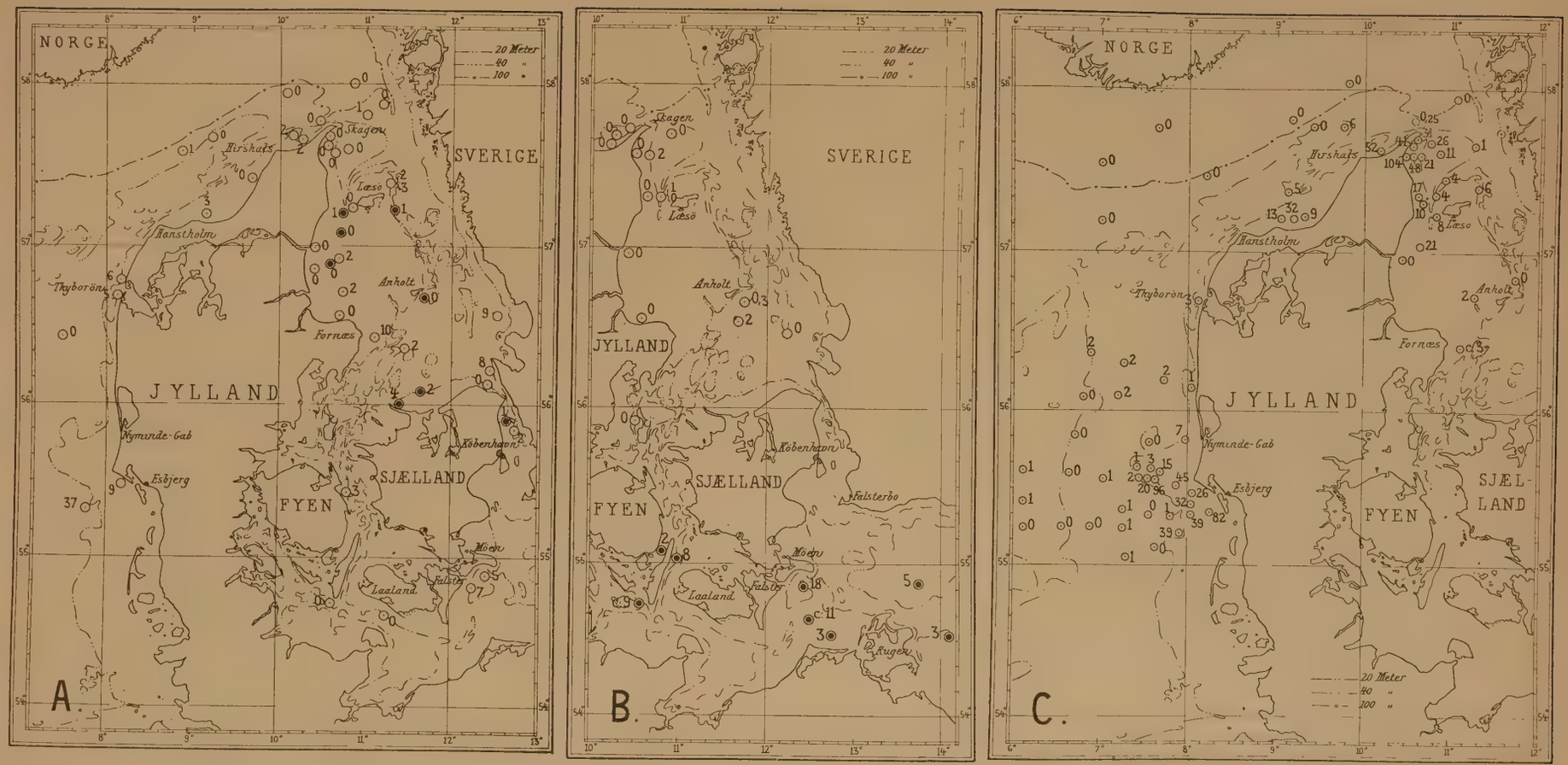

Fig. 12. No. of plaice of the III-Gr. caught per hour by 50 f. otter-trawl.

A. III-Gr. 1905 (hatched in 1902). ⊙ September—November 1905. ◉ March 1906.

B. III-Gr. 1906 (hatched in 1903). ⊙ October 1906. ◉ March 1907.

C. III-Gr. 1907 (hatched in 1904). ⊙ April—June 1907.

Bay, which surely is ascribable to the fact that the shallow grounds are far more extensive in the former than in the latter place.

As II-Gr. we find the series from 1904 in October 1906 and in March 1907 (Fig. 11 B), but the investigations are here restricted to Tannis Bay and the waters inside (or E. of) the Skagen. At last we notice the series as III-Gr. in April, May and June 1907 (Fig. 12 C).

It will be seen from all the charts illustrating the distribution and frequency of the series from 1904 that this has not been so frequently represented in the Horns Reef area as the series from 1902 and 1903, but it has, on the other hand, been far more frequent in the Skagerak and northern Kattegat than those series. While the series from 1902 and 1903 were exceedingly numerous in the Horns Reef area and only occurred sparsely in the Skagerak and northern Kattegat, such can not be said to hold good for the series from 1904. With regard to this series it is not clear whether the greatest number of plaice has grown up in the Horns Reef area, or in the Skagerak and northern Kattegat.

Finally, if we consider the distribution and frequency of the specimens hatched in 1905 and 1906 the conditions have, so to speak, been turned upside down from 1902—1903 to 1905—1906. The frequency shows a large decrease in the Horns Reef area and a large increase in the Skagerak and northern Kattegat. In these last years the Horns Reef area cannot, as regards frequency of specimens, compete with the Skagerak and northern Kattegat.

The investigations in April—June of 1907 showed a far greater frequency with regard to the I-Gr. and II-Gr. in the Skagerak and northern Kattegat than in the Horns Reef area (Table 1 and Fig. 10 E and Fig. 11 C).

In the course of the 5 years from 1902 to 1906 the centre of gravity of the young plaice population in the seas around Denmark has moved from the Horns Reef area to the Skagerak and northern Kattegat. It appears as if the Horns Reef area has grown poorer in young plaice year by year, while the Skagerak and northern Kattegat have grown richer year by year. A change in this respect will probably take place sooner or later. A tolerably durable condition concerning the frequency and distribution of the young plaice in Danish waters evidently does not exist.

Whether similar occurrences have taken place in the other grounds in the southern and south eastern part of the North Sea as in the Horns Reef grounds with regard to the frequency of the young plaice in the years 1902—1906, cannot yet be elucidated. It is not improbable that a further study of this matter in connection with an investigation of the rate of growth of the fish, may throw light upon the fact that the total yield of the plaice fishery in the North Sea can vary greatly from one year to another, and that the yield from those countries which base a great part of their fishery on small plaice, often shows the same fluctuations.

In the North Sea off the stretch Thyborøn—Ringkøbing Fjord the young plaice appear to have been proportionately scarce in the years 1902—1906.

In Aalbæk Bay considerable quantities of immature plaice are generally present. KRØYER[1] says, however, that he was told in Aalbæk "that the plaice had once been quite away from the area for 16 years". It is not improbable that the basis of this communication may be looked for in a poverty of young plaice for a longer series of years in that area.

Inside Thyborøn, in Nissum Bredning, a very rich stock of young plaice has been found in several different years by C. G. JOH. PETERSEN[2]. In the coast investigations in the summer of 1905 numerous specimens of the 0-Gr., I-Gr. and II-Gr. were again present (Table 1, p. 7, Station 493—528), and it was proved by otolith investigations that the growth of the specimens was so slight here as we

[1] HENRIK KRØYER: Danmarks Fiske. II. 1843—45. p. 272.

[2] See the Reports IV. V. VI. etc. from the Danish Biological Station.

have noticed it to be the case only in a few places in the waters surrounding Denmark[1]. To what degree the abundance of the stock varies from one year to another in this area has not yet been elucidated.

In the year 1903 the growth of the marked plaice liberated in the Horns Reef area was far slighter than in the following years. The average increase for specimens of 20—29 cm. was in 1903 ca. 4 cm., in 1904, 1905, 1906 and 1907 ca. 6—7·5 cm.[2], the total monthly averages from the marking experiments being taken into consideration at the calculation of the growth.

From the facts mentioned before (p. 32—36) and from Figs. 9, 10, 11 and 12 it will be seen that the slight increase in growth in 1903 occurred in a year, when an unusually rich stock of under-sized fish existed in the Horns Reef area, according to the "Thor"s fishing experiments.

In the following years, from 1904—1907, when the increase in growth was far quicker, the stock of under-sized fish was also far less. The feature noticed here points in the direction that the growth of the plaice largely depends on the density of the plaice population, a result which is also confirmed by a series of other observations.

Table 6. No. of plaice of the various age-groups, developed in 1902—1907, caught per station and per hour in the North Sea, the Skagerak, and northern Kattegat.

Hatching year for the plaice	Age-group when caught	Period of investigation	Depth meters	Apparatus	No. of plaice per Station and per hour				No. of Stations			
					Horns Reef	Hanstholm—Sondervig	Skagerak	Northern Kattegat	Horns Reef	Hanstholm—Sondervig	Skagerak	Northern Kattegat
1902	I-Gr. (10-19 m.)	Septbr. –Nov. 1903, Febr.—March 1904	5—20	50 f. otter-trawl	272·2	2·3	0·8	4·8	10	3	7	20
1902	III-Gr.	Septbr.—Nov. 1905, March 1906	5—40	»	23 0	3·7	1·8	0·6	2	3	4	11
1903	0-Gr.	Septbr.—Nov. 1903, Febr.—March 1904	5—20	»	54·1	1·0	7·3	1·5	8	3	7	20
1903	I-Gr. (II-Gr.) 10-19 m.	Septbr.—Octbr. 1904, March—April 1905	5—20	»	163·0	3·0	17·0	27·6	7	4	4	5
1903	II-Gr.	Septbr.—Nov. 1905, March 1906	5—40	»	76·5	8·3	9·3	2·8	2	3	4	11
1903	III-Gr.	October 1906	5—40	»	..	..	0·0	0·5	..	..	3	6
1904	0-Gr. (I-Gr.)	Septbr.—Octbr. 1904, March—April 1905	5—20	»	30·7	6·0	2·0	26·8	7	4	4	5
1904	I-Gr.	June—November 1905	0—10	Young plaice trawl	16·9	8·3	71·8	21·8	14	20	22	23
1904	I-Gr.	Septbr.—Nov. 1905, March 1906	5—20	50 f. otter-trawl	158·0	9·5	27·3	6·1	1	2	4	7
1904	II-Gr.	October 1906	5—40	»	..	..	15·3	64·3	..	..	3	6
1904	III-Gr.	April—June 1907	5—40	»	15·5	2·0	19·5	25·1	24	6	6	14
1905	0-Gr.	June—November 1905	0—10	Young plaice trawl	83·3	41·3	120·4	8·7	14	20	22	23
1905	0-Gr.	Septbr.—Nov. 1905, March 1906	5—20	50 f. otter-trawl	37·0	3·0	0·3	0·0	1	1	3	6
1905	I-Gr.	October 1906	0—10	Young plaice trawl	..	..	78·2	16·2	..	..	5	17
1905	II-Gr.	April—June 1907	5—20	50 f. otter-trawl	19·1	9·5	125·8	45·1	13	2	5	9
1906	0-Gr.	October 1906	0—10	Young plaice trawl	..	..	44·8	21·5	..	..	5	17
1906	I-Gr.	April—June 1907	5—20	50 f. otter-trawl	4·0	5·0	45·6	32·6	13	2	5	9
1906	I-Gr.	April—August 1907	0—10	Young plaice trawl	35·5	..	50·0	41·4	6	..	2	18
1907	0-Gr.	August 1907	0—10	»	..	..	..	63·7	..	..	..	9

B. The pelagic stages of plaice.

Concerning the pelagic stages, we have not been able to trace the same fluctuations in the frequency as for the bottom stages. In all the years from 1903 to 1906 we have caught many more pelagic

[1] A. C. Johansen: Ueber die Schollenfischerei im Kattegat etc. 1906 p. 107.

[2] A. C. Reichard found that the yearly increase in growth for plaice of an average length of 24 cm. only came up to 4·61 cm. in the Horns Reef area in 1905. But these plaice, as many others in the German experiments, were marked with stiff ebonite buttons, which may possibly restrain the growth of the fish considerably. Moreover they were transplanted from Heligoland, so that many of them were probably older than specimens of the same size from the Horns Reef. (Die deutschen Versuche mit gezeichneten Schollen. II. Bericht. Wissensch. Meeresunters. N. F. IX. Bd. Abt. Helgoland 1908.)

specimens in the Horns Reef area and in other places in the North Sea than in the Skagerak (see Table 5, p. 26). It is singular to note how few pelagic plaice we have captured in the Skagerak in all these years. This may partly be due to the fact that the investigations have been incomplete, but some other reasons may also be pointed out. Thus it should be remembered that only a small stock of spawning plaice exists in the Skagerak, as the great majority of old plaice are fished up there (A. C. JOHANSEN l. c. 1906). It may also be considered that the currents probably show a tendency to carry off the plaice eggs and young from the Skagerak to the North Sea. The eggs which have been spawned on the banks south of the deep channel must be carried in a north eastern direction along the northwest coast of Jutland and afterwards in a northern and western direction.

Thus it is very probable that the majority of the young bottom stages of plaice in the Skagerak off the north western coast of Jutland originate from the North Sea, and we may imagine that most of these specimens have not come to the Skagerak before they were in the metamorphic stage. The early pelagic stages of plaice coming from the North Sea to the Skagerak may probably partake in the circulation also just as the early stages originating from the Skagerak itself.

V. Statistical evidence with regard to favourable and unfavourable spawning years.

In the areas where a great "accumulated stock" of plaice exists and the yearly increase in number of young marketable fish is only scarce in proportion to the great stock of old fish always present, we cannot expect that the influence of one single year, which is unfavourable for the development of the young, could be traced much in the yield of the fishery. In other areas, where the young are developed in such quantities that an overcrowding of young fish takes place, a year unfavourable for the development of the fry may probably be advantageous as to the very area where the young fish are most numerous, as the growth of the specimens is restrained when overcrowding takes place. It should not be forgotten, however, that the most pronounced rearing places have not their greatest importance as fishing places, but in supplying young fish to less thickly populated areas. Elsewhere where the density of the population of young plaice is not specially great and where the fishing is based on the "current stock"[1], an unfavourable year for the development of the young may be recognisable through a considerable reduction in the yield in certain of the following years, and it is areas of this kind which are of the greatest extent in our waters. It should be remembered, however, that the influence of a year with an unusually small number of fry, may be checked by the influence of a preceding or ensuing year with an unusually great number of fry.

We have examples of areas of all the three categories in our waters. The Baltic, and, to a certain degree, the Belt Sea, form examples of waters with a great accumulated stock of plaice on which the fishery is mainly based. The inner Horns Reef grounds and the western expansions of the Limfjord give examples of waters where very great quantities of young are generally accumulated, and Aalborg Bay is again a water in which we find no specially great stock of young plaice and where the fishery is based exclusively on the "current stock", that is young and rapidly growing specimens.

In Aalborg Bay the growth of the plaice takes place proportionately fast. In the third and fourth summer, as II-Gr. and III-Gr., most specimens in Aalborg Bay pass the Danish size limit: 25·6 cm. (A. C.

[1] H. M. KYLE: Statistics of the North Sea fisheries. Part II. Rapports et Procès-Verbaux. Vol. III. 1905.

JOHANSEN l. c. 1906 and Contributions II 1907). The question here is whether the unfavourable spawning year in 1904 has made itself felt in Aalborg Bay through a considerable reduction in the yield of the fishery in the years 1906 and 1907.

Statistics concerning the total yield of the plaice fishery in Aalborg Bay cannot be procured. Statistical information is, however, to hand with regard to the yield of different Danish Snurrevaad-cutters' catch per day in Aalborg Bay for a series of years. This information, which has been extracted from the journals of the Danish cutters, is recorded below.

Table 7. A cutter's average catch of plaice per fishing day in Aalborg Bay.

Year	Average catch per day in scores	No. of fishing-days forming the basis of calculation	Year	Average catch per day in scores	No. of fishing days forming the basis of calculation
1880	61·1	103	1893	49·5	101
1881	62·9	88	1894	47·0	113
1882	79·0	100	1895	78·6	371
1883	75·6	68	1896	57·4	264
1884	85·9	82	1899	41·1	566
1885	62·2	146	1900	38 5	633
1886	52·0	144	1901	45·2	546
1887	34·8	152	1902	42·1	267
1888	43·9	109	1903	[101·8]	10
1889	32·2	108	1904	35·2	88
1890	36·7	206	1905	48·4	67
1891	34·6	205	1906	27·2	123
1892	62·5	298	1907	26·7	70

Table 7 is for the years 1880—1889 based on the Danish „Fiskeri-Beretning" for the years 1890—1907 on Captain C. J. HANSEN's calculations. The cutters from the first mentioned period were of the old type without motor and screw, whilst those in the latter period have been provided with steam or motor power.

From the Table it will be seen that a reduction in the yield has taken place in the course of the years from 1880—1907, and that great fluctuations occur from one year to another. The first feature may be owing to the circumstance that more and more cutters take part in the fishery year by year, for which reason the yield of each cutter becomes smaller and smaller. As to the second feature — the great fluctuations in the yield — we shall probably for the greater part have to look for fluctuations in the frequency of the young plaice in the different years. In this connection it is very interesting to notice that the yield was unusually small in 1906 and 1907, two and three years after the unfavourable spawning year 1904. It should here be remembered that the material on which the present statistics are based is very reliable, though not very copious.

In the southern Kattegat, where we still find a rather considerable stock of older mature plaice, it cannot be expected that an unfavourable spawning year should exercise as great an effect in the direction of a reduction in the yield of the fishery in some of the ensuing years as in Aalborg Bay, where only a current stock of plaice exists. In the statistics at hand concerning a cutter's yield per fishing day in the southern Kattegat it may, however, also be traced that the yield in 1906 and 1907 was unusually scanty (see Table 8). The statistics are, however, here based on a far smaller material than with regard to Aalborg Bay. Statistics of the total yield of the plaice fishery in the southern Kattegat cannot be procured.

It is interesting to notice that the same fluctuations in the yield occur for the southern Kattegat as for Aalborg Bay. The years 1892—1896 indicate thus in both places a great yield in comparison with the two preceding and all the ensuing years, and the years 1906 and 1907 show in both places the very smallest yield which has been observed on the whole.

Table 8. A cutter's average catch of plaice per fishing day in the southern Kattegat.

Year	Average catch per day in scores	No. of fishing days forming the basis of calculation	Year	Average catch per day in scores	No. of fishing days forming the basis of calculation
1890	52·5	56	1900	40·4	101
1891	64·3	24	1901	49·6	82
1892	121·4	15	1902	47·0	185
1893	86·6	5	1903	70·1	7
1894	117·8	23	1904	45·6	16
1895	89·3	13	1905	47·8	39
1896	71·6	16	1906	32·4	19
1899	33·5	122	1907	33·0	94

The total yield of the Danish plaice fishery in the Belt Sea in 1902—1907 can, according to the Danish Fiskeri-Beretning, be put down as follows:

1902..... 151,000 scores (à ca. 5 kilos.)
1903..... 155,000 — —
1904..... 179,000 — —
1905..... 186,000 — —
1906..... 228,000 — —
1907..... 157,000 — —

It will be seen that there is a gradual increase in the yield from 1902 to 1907, probably owing to a gradual increase in the amount of fishing. Then comes a sudden fall in 1907. It is easy to suppose that it is the small supply of young plaice of the series hatched in 1904 which has made itself felt in 1907. Very few plaice in the Belt Sea pass the Danish size limit (25·6 cm.) in their third year, but a great part, especially of the females, pass it in their fourth year, as III-Gr.

To what degree the movement which has taken place with regard to the decrease in the frequency of young plaice in the Horns Reef area in the years 1902—1906 and the contemporary

Table 9. Mean salinity in the surface water at the Danish ligh
(The figures in thick type indicate a low

Place of observation	January																					
	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1893-1907	1893	1894	1895	1896	1897	189
Skagens Rev	ice	**29·9**	**27·5**	**29·0**	**27·6**	31·6	31·7	**28·0**	**29·2**	32·1	31·0	**27·9**	32·3	31·1	31·8	30·1	ice	32·2	ice	31·8	ice	32·
Læsø Trindel	ice	**25·0**	**24·8**	**25·8**	**25·9**	29·5	27·7	**21·1**	**25·3**	30·2	27·8	**24·0**	30·4	26·8	29·3	26·7	ice	30·3	ice	30·5	ice	29·
Læsø Rende	ice	**25·4**	**25·4**	**24·8**	**24·7**	28·2	27·9	**21·1**	**25·7**	30·6	27·8	**22·9**	29·5	26·7	28·8	26·4	ice	30·8	ice	29·9	ice	28·
Kobbergrund	ice	**23·3**	ice	**23·2**	**23·9**	26·5	27·2	**18·8**	**22·7**	29·3	26·7	**20·5**	28·2	25·3	27·8	24·9	ice	29·5	ice	28·4	ice	27·
Anholt Knob	ice	**20·9**	**22·2**	**21·9**	23·4	24·2	25·3	**16·9**	**20·5**	25·9	24·5	**17·2**	25·5	22·8	24·5	22·6	ice	25·6	ice	24·9	ice	25·
Schultz's Grund	ice	**17·5**	**19·1**	**19·3**	20·5	22·6	23·3	**15·3**	**17·5**	22·3	21·1	**16·8**	22·3	20·8	20·6	19·9	ice	22·8	ice	21·2	ice	23·
Middelfart	...	...	**20·0**	**19·3**	**18·1**	23·3	22·8	**16·8**	**18·5**	21·0	**19·5**	**19·4**	22·3	20·1	20·6	20·1	...	...	...	21·5	**19·8**	23·
Svendborg Sund	...	...	**18·2**	16·7	**16·4**	19·9	20·1	**15·6**	**17·1**	**17·6**	**17·6**	18·3	19·7	19·5	20·6	18·3	...	...	**15·8**	19·5	**18·2**	20·
Refsnæs	16·2	**15·7**	17·5	17·8	**14·4**	17·2	...	**10·7**	**14·2**	17·6	...	**13·1**	19·2	16·7	**15·5**	15·8	**11·9**	17·0	...	17·3	**13·7**	18·
Sprogø	...	**15·0**	**16·6**	17·9	**17·0**	22·1	19·2	**13·9**	**14·9**	20·0	17·9	**16·7**	19·3	**17·4**	18·2	17·6	...	21·8	**14·6**	19·5	21·6	20·
Spodsbjerg	...	(15·3)	**(13·7)**	16·0	**12·7**	...	...	**12·3**	**14·0**	18·4	15·5	**15·0**	17·4	15·4	16·5	15·2	...	(20·4)	...	18·7	**13·8**	...
Lappegrund	ice	**14·5**	**12·1**	18·0	15·7	19·9	**14·5**	**14·3**	**13·0**	18·6	**14·0**	**14·4**	15·7	**14·7**	15·8	15·4	ice	17·7	ice	16·6	ice	14·
Drogden	ice	13·4	**9·3**	13·4	**11·5**	14·0	**11·3**	**10·9**	**11·9**	16·5	**12·0**	**12·0**	13·0	**11·3**	12·7	12·4	ice	16·2	ice	13·7	ice	12·
Gedser Rev	ice	**10·1**	**10·7**	11·8	**10·9**	14·2	**11·3**	**9·6**	11·5	14·7	**11·3**	**11·0**	12·5	**10·3**	**11·0**	11·5	ice	14·8	ice	12·7	ice	12·
Christiansø	...	...	...	...	...	7·2	7·2	**6·8**	7·0	**6·5**	**6·4**	**6·1**	7·7	7·1	**6·8**	6·9	...	...	...	...	...	7·

increase in the Skagerak and northern Kattegat has made itself felt in the yield of the fishery, cannot be accounted for till the statistics concerning the fishery in the years 1907—1909 are to hand.

VI. Causes of observed variation in frequency of young plaice in Danish waters.

In discussing the causes of the unequal frequency of young plaice in the different years, we must distinguish between the areas which previously have been treated separately, namely on one side: the middle and southern Kattegat, the Belt Sea and the Baltic, and on the other side, the shore belt off the west-coast of Jutland and the northern Kattegat.

It will be remembered that only very slight quantities of young plaice of the 0-Gr. were found in the middle and southern Kattegat and the Belts in 1904 in proportion to the two preceding and two ensuing years.

This feature should be kept in mente when we study the Tables 9, 10 and 11, which have been worked out after the Danish Nautical-Meteorological Annual, and which indicate the salinity observations from the Danish light-vessels, and, as regards Table 9, also from various coast stations, for a series of years and for the months of January, February and March, or the months in which the spawning of the plaice essentially takes place.

It will then be seen that the salinity in the surface waters was abnormally low in the first months of the year 1904, especially in the Kattegat. Also the isohalines drawn up on the charts of Figs. 1, 3 and 4, point to the fact that the surface waters in the northern and middle Kattegat were of a far lower salinity in the beginning of February 1904 than it was during the same season in the two preceding and three ensuing years[1].

[1] These isohalines are for the years 1903, 1905, 1906 and 1907 reproduced from "Bulletin trimestriel. Cons. perm. internat." while those for the years 1902 and 1904 have been constructed by Mr. J. P. Jacobsen, who has kindly placed them at my disposal.

ssels and several coast stations in January—March 1893—1907.
inity than the mean value for 1893—1907.)

ruary										March															
99	1900	1901	1902	1903	1904	1905	1906	1907	1903-1907	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1893-1907
1·0	27·7	31·3	30·1	32·5	27·0	33·3	31·5	31·2	31·0	ice	31·4	ice	31·4	30·3	29·4	32·6	29·0	25·7	28·8	32·0	24·9	29·1	30·9	32·2	29·8
4·9	23·7	ice	23·3	32·5	23·6	30·9	27·5	26·7	27·5	ice	25·3	ice	24·7	26·1	24·4	27·2	27·2	ice	19·1	27·7	21·2	18·2	28·2	30·3	24·9
7·2	ice	25·3	27·0	31·3	25·6	30·5	26·9	26·8	28·2	ice	26·1	ice	25·3	25·8	26·6	28·3	25·3	21·6	23·1	28·0	22·6	24·2	28·1	30·7	25·8
5·2	ice	ice	24·6	30·7	22·8	29·0	25·3	25·3	26·9	ice	24·4	ice	23·9	24·5	23·7	23·9	...	ice	19·7	24·7	20·1	19·3	26·1	28·7	23·5
2·3	21·0	ice	20·2	27·4	20·7	26·3	22·6	22·3	23·6	ice	22·0	ice	21·5	22·8	19·5	22·2	23·7	ice	16·6	22·4	18·7	16·1	22·4	23·6	21·0
8·8	18·8	ice	16·6	24·9	21·1	21·2	19·5	19·8	20·7	ice	16·9	ice	18·8	18·0	15·7	19·2	20·7	ice	15·4	18·0	16·5	12·8	20·5	23·0	18·0
9·5	16·2	19·1	17·8	23·0	19·6	21·3	19·0	19·9	20·0	...	(16·7)	18·7	19·8	19·0	18·7	19·1	16·4	17·3	16·6	18·7	16·8	16·3	20·1	20·9	18·2
7·8	15·6	16·8	16·9	19·2	19·3	19·5	19·1	21·1	18·4	...	...	16·4	17·7	17·4	16·1	16·1	15·7	15·3	14·0	17·8	18·3	17·7	18·9	20·5	17·1
3·8	13·8	16·5	13·8	...	16·7	18·6	16·7	13·7	15·6	16·7	13·9	12·5	13·9	12·8	12·5	13·8	16·5	12·6	12·7	...	13·9	10·4	16·7	19·2	14·2
5·3	14·8	16·5	12·6	24·6	17·1	20·1	16·6	17·0	18·1	(20·2)	13·9	17·0	15·8	14·9	13·3	16·5	17·1	12·9	13·7	15·2	13·7	10·8	18·6	19·9	15·7
..	12·1	14·8	10·4	22·1	14·9	18·0	14·3	15·5	15·9	...	(9·8)	13·8	13·0	14·6	...	...	13·8	10·5	11·9	13·1	11·8	9·7	16·4	18·4	13·1
1·8	11·9	ice	9·2	22·0	15·8	16·2	12·1	14·3	14·8	ice	12·3	ice	13·5	13·9	11·1	14·6	18·2	11·6	13·2	13·1	11·4	9·9	16·8	14·6	13·4
9·6	8·6	ice	8·5	16·3	10·7	12·7	9·3	12·1	11·8	ice	9·5	ice	9·9	10·6	10·1	11·2	11·3	8·6	9·4	10·8	9·2	8·6	13·4	11·3	10·3
9·4	9·2	9·4	8·6	15·9	10·2	13·2	9·8	11·3	11·4	ice	9·0	ice	11·0	10·1	9·6	10·7	10·8	8·6	8·9	9·4	8·1	7·9	12·3	10·9	9·8
5·0	6·1	6·1	6·8	6·7	6·4	7·1	6·4	...	6·6	...	...	...	...	...	6·2	6·7	7·0	6·8	6·4	7·0	5·5	6·5	6·4	6·7	6·5

Table 10. Mean salinity at 10 meters depth at the Danish light-vessels E. of the Skagen in January—March 1902—1907.

Place of observation	January							February							March						
	1902	1903	1904	1905	1906	1907	1903-1907	1902	1903	1904	1905	1906	1907	1903-1907	1902	1903	1904	1905	1906	1907	1903-1907
Skagens Rev	32·6*	32·4	31·5	33·2	32·4	32·2	32·3	33·0*	32·8	29·5	33·7	32·6	32·3	32·2	32·7*	32·5	30·1	32·9	32·0	32·5	32·0
Læsø Trindel	31·8*	29·2	26·6	31·6	28·5	30·4	29·3	28 7*	32·7	26·9	32·8	28·8	29·0	30·0	27·2*	29·2	26·6	21·7	29·6	31·6	27·7
Læsø Rende	31·7*	30·2	29·6	30·7	30·2	29·7	30·1	30·0*	32·4	27·7	31·7	29·6	28·6	30·0	30·9*	30·3	28·5	29·5	29·2	31·4	29·8
Kobbergrund	30·7*	28·3	27·9	30·3	27·6	29·6	28·7	29·2*	32·0	26·9	31·3	28·6	28·8	29·5	28·4*	28·1	25·5	28·2	27·6	31·0	28·1
Anholt Knob	26·8*	25·7	19·5	26·8	23·8	25·6	24·3	23·4*	27·9	22·7	27·2	24·0	23·6	25·1	21·1*	24·5	21·3	18·6	23·7	24·9	22·6
Schultz's Grund..	23·3*	23·4	19·5	23·2	22·7	22·3	22·2	19·5*	25·7	22·2	21·8	21·0	21·7	22·5	22·8*	19·8	20·3	15·0	21·5	23·9	20·1
Lappegrund	22·6*	22·2	25·7	19·5	21·3	20·9	21·9	22·2*	23·7	26·9	19·6	20·5	23·2	22·8	26·5*	20·6	28·5	22·2	19·8	20·9	22·4
Drogden (6 meters)	16·9	12·7	13·8	13·3	12·2	13·4	13·1	8·8	17·5	12·2	13·6	10·0	12·9	13·2	11·9	11·7	10·6	9·1	14·0	11·8	11·4
Gedser Rev (11 m.)	16·9	12·5	12·9	13·2	11·3	13·7	12·7	8·9	16·5	11·8	14·0	10·3	11·8	12·9	11·8	11·6	10·3	8·2	13·5	13·4	11·4

Table 11. Minimum salinity at 10 meters depth at the Danish light-vessels E. of the Skagen in January—March 1902—1907.

Place of observation	January						February						March					
	1902	1903	1904	1905	1906	1907	1902	1903	1904	1905	1906	1907	1902	1903	1904	1905	1906	1907
Skagens Rev	28·5*	29·6	26·1	29·1	31·4	29·2	29·7*	32·2	23·0	32·9	31·8	31·1	30·2*	31 4	24·0	26·6	28·8	31·8
Læsø Trindel	24·5*	26·3	18·9	27·3	24·2	25·8	23·7*	31·8	22·5	30·9	22·1	22·8	21·2*	22·3	22·0	16·6	23·9	30·1
Læsø Rende	25·7*	25·5	23·0	27·1	25·5	26·8	24·4*	29·9	24·3	27·1	25·5	25·1	24·4*	27·4	23·5	23·8	25·3	29·2
Kobbergrund	22·6*	26·2	22·0	25·7	24·2	26·2	25·2*	30·4	21·4	25·7	23·7	24·0	20·7*	22·0	17·6	22·5	22·9	28·8
Anholt Knob.....	19·6*	22·1	16·0	23·5	20·5	22·6	18·6*	24·2	19·8	26·1	20·4	21·6	15·5*	17·7	18·8	14·2	20·3	23·0
Schultz's Grund..	16·7*	19·5	14·5	16·5	18·8	16·8	14·2*	23·3	20·0	18·5	16·0	17·1	15·2*	12·8	16·0	11·8	17·9	22·8
Lappegrund	13·9*	9·5	17·8	11·8	9·9	8·5	10·7*	17·4	22·6	10·0	11·9	19·0	19·1*	11·2	17·8	11·7	10·3	15·8
Drogden (6 meters)	9·2	8·5	7·5	8·6	7·8	7·8	8·0	9·3	8·0	9·1	8·0	7·7	8·1	8·8	6·8	7·5	8·3	8·2
Gedser Rev (11 m.)	9·7	8·6	7·7	8·2	7·9	8·3	8·1	12·9	7·9	8·7	8·0	8·0	7·9	8·2	7·3	7·6	8·4	8·4

* Observations taken at 11 meters depth.

The unusually low salinity in the upper layers of our inner waters in the first months of the year 1904 was followed by an abnormally scarce occurrence of plaice of the 0-Gr. in the said waters in the same year, and we have reason to suppose that there is a causal relation between these two phenomena.

It is a well known fact that the plaice show a certain sensibility to water of a low salinity. They do not occur normally in water of less salinity than 5 ‰, and demand a considerably higher salinity in certain stages of their development. Hensen states that the spermatozoa of plaice (in Kieler Bay) appeared almost unmoveable when transferred into water of a salinity of less than 14 ‰[1]. We do not know the minimum salinity which the plaice eggs demand in order to develop when fecundation has taken place. On board the "Thor" we have hatched plaice eggs with large embryos in water of only 8 ‰, but the eggs cannot keep floating in water of such a low salinity, and this very circumstance as to whether the eggs keep floating or not, evidently plays in nature a very important part concerning their fate.

[1] Hensen: „Vorkommen und Menge der Eier einiger Ostseefische" Bericht der Commission zur wiss. Unters. d. deutschen Meere in Kiel. IV. 1884.

Whether they, as a rule, perish under natural exposure solely because they lie on the bottom and become covered by particles falling down from the sea water, is an open question. It is, however, hardly to be doubted that the eggs at all events are far more liable to become a prey for enemies when resting on the sea bottom than when suspended in the water.

The specific gravity of the plaice eggs is, like the specific gravity of the majority of other pelagic fish eggs, very variable. They are in a high degree adapted to the water in which they occur. In the Skagerak the author has found plaice eggs the specific gravity of which were like the sea water of 35 ‰, and in the Baltic others with a specific gravity as low as sea water of 10 ‰. But the power of adaptation has its presribed limits[1], and when the salinity comes down to a certain degree, which varies very much in different places, the eggs will sink to the bottom.

In the deeper parts of the Kattegat and the Belt Sea there will always be water of a sufficient specific gravity to keep plaice eggs floating, but in the more shallow areas, which are of a considerable extent, e. g. Aalborg Bay, the conditions may probably at certain times become critical, so that the eggs sink to the bottom in quantities.

Even if some plaice eggs are still able to float in sea water of a salinity of 10 ‰, and even if the spermatozoa may still move in water of a somewhat similar salinity, the optimum for the fecundation and development of the eggs must evidently be looked for at a far higher salinity. The vertical distribution of the plaice eggs in our southern waters suggests already something in this direction. Even in the Belt Sea only few plaice eggs occur in water of less than 15 ‰, and most of them are suspended in water of a considerably higher salinity.

It is thus quite natural that in the winter months of those years in which the salt water in the Kattegat and the Belt Sea becomes more than usually mixed up with water of a low salinity from the Baltic, the life conditions will be more unfavourable to the young plaice than in other years.

While no plaice eggs seem able to float in water of less salinity than ca. 10 ‰, the pelagic larvæ may occur in water of a far less salinity.

During the "Thor"s investigations in the true Baltic in May of 1908 we found several times plaice larvæ in water of 7—8 ‰, and it is by no means proved that they cannot occur in still fresher water. The young bottom stages have also several times been taken in the Baltic in water of a salinity of 7—8 ‰. We have thus hardly reason to doubt that a relatively low salinity in our waters is more critical to the eggs than to the larval stages and young bottom stages. A proportionately low salinity is probably most destructive to the plaice at the time when most eggs and most spermatozoa occur in the water, or in our waters in January and February. In the month of March, when many plaice eggs are hatched, or in April, when most of them are hatched, the unfavourable influence of the low salinity is probably less.

If we assume the low salinity in the upper layers of the middle and southern Kattegat and Belts in the beginning of the year 1904, especially in January and February, to be the reason why the plaice fry were so scarce in that year, it is to be expected that the year 1900 also must have been a most unfavourable one for the development of the young in these waters, as the salinity in the upper layers in the first months of that year was at least as unusually low as in 1904. (See Table 9 p. 40—41). It is, therefore, of great interest that the sporadic investigations to hand just point in the direction, that only small quantities of young plaice have been present in these waters in 1900. Dr. PETERSEN writes about this as follows in Report XII of the Danish Biological Station (p. 15): "In 1900, in June and July, the fry was found in the northern part of the Cattegat and in the mouth of the Isefjord; at the latter place only in small numbers. At Samsø only a few were found, and at

[1] J. P. JACOBSEN and A. C. JOHANSEN: Remarks on the changes in the specific gravity of pelagic fish eggs etc. Medd. fra Kommissionen for Havundersøgelser. Serie: Fiskeri. Bd. III. 2. 1908.

Reersø in the northern part of the Great Belt, in spite of eager investigation, only 2 specimens. At Laaland, in spite of eager investigation, we found none. I still remember, distinctly, my astonishment at finding so few fish that year, as I had formerly caught many more in the Belt-Sea". It should, however, be stated, that if the year 1900 has been unfavourable for the occurrence of the plaice fry also in the middle and southern Kattegat, we have not been able to trace this in the statistical information to hand concerning a cutter's average catch per day in the years 1902 and 1903. (See p. 39—40).

Apstein found, as mentioned before (p. 15), that only slight quantities of plaice occurred off Eckernförde and Kiel in 1893 and 1895, and according to Petersen's investigations, the young plaice were also very scarce off the coasts of the southern Danish isles in 1893. In both these years we had pronounced ice winters, so that the light-ships inside the Skagen were drawn in for a longer time. A low salinity has also been noticed in the surface water in January and February of these years. (See Table 9 p. 40—41). These two occurrences may possibly both have contributed to produce unfavourable years for the development of the young. The plaice does not reach up to high arctic regions, and it is not at all improbable that a strong and enduring influence of a low temperature is injurious to the plaice in the spawning time or in its earliest stages of development.

At any rate we ought in future to turn our attention to the question whether hard winters are not continuously followed by a scarce occurrence of plaice fry.

The reasons of the great variation in the frequency of the plaice fry in the Horns Reef area and the Skagerak can hardly be elucidated at present. It is noteworthy, that it appears that in the years in which proportionately great quantities of young are present in the Horns Reef area, they occur proportionately sparsely in the Skagerak, and vice-versa. Whether this really is the general rule can only be settled by future investigations. It is possible that small differences with regard to the currents may have the effect that proportionately many plaice larvæ in the metamorphic stages sink to the bottom in certain years in the Horns Reef area and proportionately few in the Skagerak, while in other years quite the reverse takes place. However, no further details are known at present concerning this question.

VII. On the importance of the investigations from a practical point of view.

The actual question about transplantation of plaice from areas where they are exceedingly numerous and increase slowly in growth to areas where they are scarce and increase quickly, is closely connected with the quantitative investigations which have been mentioned in the preceding sections. These investigations have hitherto, however, been of a somewhat limited and casual character, but the results which they have yielded strongly invite us to make them of a more permanent and systematic character in future.

The investigations have proved that if only slight quantities of fry have been developed in a certain year within a larger area such as the middle and southern Kattegat and the Belts or the Skagerak, this want of young is not compensated for by immigration from the adjacent waters in the following years. If for instance the young have been plentiful in the Skagerak and scarce in the Kattegat, we have surely been able to trace a considerable immigration from the Skagerak to the northern Kattegat but not to the middle or southern parts of the waters. We know from experience that a scarcity of the 0-Gr. in the middle and southern Kattegat also means a scarcity of the corresponding I-Gr. and II-Gr. etc.

It will be seen from the investigations which have been carried on from the "Thor" that only slight quantities of young plaice are generally present in the middle Kattegat (limited by the 57° northern parallel and the line Fornæs-Kullen) but those which occur show a proportionately rapid growth. Marking experiments have also shown that a very considerable percentage of the liberated specimens were recovered in the course of one year (ca. 50 %), and for the greater part in the same area in which they were liberated (A. C. Johansen l. c. 1906 and 1907). We have evidently an area here which seems suitable for planting-out and feeding grounds, and the possibility presents itself that the middle Kattegat may in future be of great importance in this respect.

We have now seen that the young plaice with regard to abundance is subject to considerable variation also in the middle Kattegat from one year to another, even if the frequency of the young has not been very great in any of the years during which the investigations have been carried on. The number which we plant out must depend on that existing in the place beforehand. The greatest yield is neither obtained where we find a very thin population of rapidly increasing specimens nor in the places where a very dense population of slowly increasing specimens occurs. The question is here, as elsewhere, to procure the most advantageous population.

As soon as it is a question about transplantation of young plaice into the middle Kattegat on a commercial scale, the query arises, where to take these young fish from? We cannot know this unless we are continuously à jour with the distribution and abundance of the young fish in the different areas of our waters. The nearer the place of liberation whence the young fish may be fetched, the cheaper the transplantation. In certain years they may perhaps be taken in Aalbæk Bay without the stock in the northern Kattegat being diminished too much. In other years the young ought perhaps to be fetched from the western "Bredninger" of the Limfjord or from the North Sea.

Various experiments which of later years have been undertaken with regard to transplantation of young plaice from Nissum Bredning to the Isefjord at Sealand, have shown that young plaice may very well grow and thrive in water of a far lower salinity than that from which they have been taken. The salinity of the water in Nissum Bredning is of more than 30 ‰, in the Isefjord of ca. 20 ‰. Owing to the difference in the salinity of the water we need not entertain any fear as to fetch the specimens destined to be planted out in the middle Kattegat from Nissum Bredning or the North Sea. The increase in growth of the transplanted specimens has in the Isefjord been so considerable that a yearly planting out on a rather large scale would seem to be desirable in this water.

In the treatise „Ueber die Schollenfischerei im Kattegat" etc. (1906), where I discuss the question about a transplantation of plaice to the middle Kattegat, I emphasized that it would be desirable, before such a transplantation on a large scale took place, that suitable laws of protection for the young fish should be established by a Convention between Sweden and Denmark. If the size limit which is in force now, was only raised 2 to 3 cm. the protection would probably be of great value. The expense of transplantation per specimen would come up to 1 to 2 Øre, and by establishing a size-limit of f. i. 28 cm. we should secure that almost no specimens would be landed before they had reached a value of more than 10 Øre. The increase in value about which it is a question here, viz. from 1 to 2 Øre to more than 10 Øre, can be reached in the course of one single summer.

In the open waters around Denmark no other areas than the middle Kattegat have hitherto been pointed out as suitable planting-out grounds for young plaice. In certain years where only small quantities of young plaice are present in the Skagerak, this water might also seem to be a suitable planting-out ground. As set forth previously by the author (l. c. 1907) it has, however, appeared in marking experiments, that many of the specimens liberated in the Skagerak emigrate to the North Sea, and this fact will always reduce the prospects of an advantageous transplantation to the Skagerak.

A systematic investigation of the distribution and frequency of the younger series of plaice will

not only be of importance with regard to the question of transplantation but also be of value in procuring information concerning the fishery in future. The statistical information to hand suggests that bad spawning years have left their greatest trace in the yield of the fishery in the middle and southern Kattegat 2 and 3 years later and in the Belts 3 years later. It also appears, on the other hand, as if an overcrowding of young fish had existed in certain places, and that this has restrained the yield in the year in question (Horns Reef area in 1903). These and similar experiences gained in future may prove to be of great importance.

Summary of the results.

1. In various parts of Danish waters we have noticed a great variation with regard to the frequency of the young plaice hatched in the years 1902—1907.

2. For the middle and southern Kattegat, the Belts and partly the Baltic the investigations have yielded the following results:

In the year 1904 far less quantities of young plaice of the 0-Gr. were present in these waters than in the two preceding and the three ensuing years (Chap. III p. 15—29).

The year 1904, unfavourable for the development of the young in the middle and southern Kattegat and the Belts, was followed by a very small yield of the plaice fishery two or three years afterwards. The statistical information thus suggests that the yield of the plaice fishery in the middle and southern Kattegat was unusually low in the years 1906 and 1907 and in the Belts in 1907. (Chap. V p. 38—40).

In the first months of 1904, in January, February and March, thus in the main spawning time of the plaice, the surface water was in the Kattegat and partly in the Belt Sea of an unusually low salinity. It is very probable, that the reason of the scarce occurrence of the young plaice of the 0-Gr. in 1904 must be looked for in this feature (p. 41—43 and Figs. 1, 3 and 4).

In the first months of the year 1900 a similar low salinity occurred in the surface waters in the Kattegat and in the Belt Sea as in 1904 (see Table 9 p. 40—41). Also in 1900 only small quantities of plaice of the 0-Gr. were present in the southern Kattegat and the Belt Sea according to Dr. PETERSEN's investigations (p. 43—44 and p. 15).

It is rather probable that hard winters also may exercise an injurious influence on the development of the young plaice. The hard ice winters in 1893 and 1895 were followed by a very scarce occurrence of plaice fry, at any rate in certain parts of the Belt Sea (p. 44 and p. 15).

The same fluctuations with regard to the frequency of the plaice fry in the years 1904—1906 which were pointed out through rather extensive investigations of different annual series of bottom stages, may also distinctly be noted for the pelagic stages, in spite of the fact that only the results of limited and quickly undertaken investigations are to hand concerning the distribution and frequency of these stages. (P. 24—29; Table 5 p. 26 indicates the "Thor"s captures of the pelagic stages of the plaice in Danish waters in the years 1903—1907).

3. With regard to the coast belt off the west coast of Jutland and the northern Kattegat the investigations have given the following results:

In 1902 and 1903 great quantities of plaice fry were present in the Horns Reef area and much smaller quantities in the Skagerak and northern Kattegat. In 1904 a more equal distribution of the young of the 0-Gr. took place within these two areas. In 1905 the young in the Skagerak were more

frequent than those in the Horns Reef area, and the turning was continued in the same direction in 1906, in which year very many young of the 0-Gr. were also present in the northern Kattegat (Chap. IV p. 30—38).

There seems to be a sort of correlation between the plaice population in the Horns Reef area and that in the Skagerak. When the young plaice have been numerous in one of these areas, they have been scarce in the other (p. 30—37).

4. In 1903, when an unusually rich stock of undersized plaice occurred in the Horns Reef area, the growth of the marked plaice of 20—30 cm. was very slow (ca. 4 cm.) In 1904, 1905, 1906 and 1907, when the stock of undersized plaice in the Horns Reef area was less, the growth of the marked plaice was far more rapid, viz. 6·0—7·5 cm. annually (p. 37).

5. Only very small numbers of plaice fry seem to be hatched in the Skagerak itself. There may be reason to think that the majority of the young plaice of the 0-Gr. off the Danish coast of the Skagerak come from the North Sea (p. 38 and Table 5 p. 26—29).

6. The investigations indicate that proportionately few young plaice are generally present in the middle Kattegat, even if the same small quantities of the 0-Gr. do not appear every year. Previous investigations have shown that the plaice in the middle Kattegat has a relatively quick growth, and that a great percentage of the marked specimens are recovered in the first year after liberation in the same area (ca. 50 %). Several conditions thus suggest that it might be desirable to undertake transplantations on a commercial scale from the areas where there is over-population of young plaice to the middle Kattegat, especially in the years in which the natural stock of young plaice passing the size limit in the middle Kattegat is less there than usual (Chap. VII p. 44—46).

7. As the fluctuations concerning the abundance of specimens of the 0-Gr. of plaice seem distinctly to make themselves known through fluctuations in the yield of the fishery in certain of the following years, there is a probability that we may be able to foretell certain main features with regard to the future yield of the fishery by means of the results of regular yearly investigations of the frequency of young plaice (Chap. V, 38—41 and Chap. VII p. 44—46).

I wish to thank Mr. H. Blegvad and Mr. Fr. Heide who have assisted me in working out the Tables 1 and 5 of this paper. — The statements about the positions of the stations are due to the "Thor"'s sailing master Mr. C. Hansen.

CONTENTS.

Page

I. **Introduction** ... 3
1. Introductory remarks ... 3
2. Method of the investigations ... 3
3. On the apparatus employed in fishing for plaice ... 4
4. On the limitation of the different waters ... 5
II. **General view over the distribution of the younger series of plaice in Danish waters** ... 5
III. **Variation in the frequency of young plaice in the middle and southern Kattegat (S. of 57° N. Lat.), the Belt Sea and the Baltic** ... 15
A. The bottom stages of plaice ... 15
1. Investigations between 1893 and 1901 ... 15
2. Investigations from the Danish Biological Station in the years 1902, 1904 and 1905 ... 15
3. The German investigations in 1903—1906 ... 16
4. Investigations from the Danish research steamer «Thor» from 1903—1907 ... 18
B. The pelagic stages of plaice ... 24
IV. **Variation in the frequency of young plaice off the west coast of Jutland and in the northern Kattegat from 1902—1906** ... 30
A. The bottom stages of plaice ... 30
B. The pelagic stages of plaice ... 37
V. **Statistical evidence with regard to favourable and unfavourable spawning years** ... 38
VI. **Causes of observed variation in frequency of young plaice in Danish waters** ... 41
VII. **On the importance of the investigations from a practical point of view** ... 44
Summary of the results ... 46

LIST OF TEXT FIGURES.

Fig. 1. No of plaice of the 0-Gr. caught by hand shove net in 1902, 1904, 1905 ... 17
— 2. Graphic representation of the average number of plaice of the 0-Gr. caught per 100 meters' haul by hand shove net in 1902, 1904, 1905 ... 18
— 3. No. of plaice of the 0-Gr. caught by different apparatus in 1903 and 1904 ... 19
— 4. No. of plaice of the 0-Gr. caught per hour by Young plaice trawl (0-Gr. 1905, 1906, 1907) ... 21
— 5. No. of plaice of the I-Gr. caught per hour by Young plaice trawl from 1905—1907 ... 22
— 6. Graphic representation of the catch of plaice of the 0-Gr. in Tannis Bay, the northern Kattegat, the middle and southern Kattegat and Belts in 1905—1906 ... 23
— 7. Graphic representation of the catch of plaice of the I-Gr. in the middle and southern Kattegat and Belts in 1905—1906 24
— 8. Graphic representation of the catch of plaice of the II-Gr. in the middle and southern Kattegat from 1905—1907 ... 24
— 9. No. of plaice of the 0-Gr. caught per hour by 50 feet otter-trawl (0-Gr. 1903, 1904, 1905, 1906) ... 31
— 10. A and B. No. of plaice of 10—19 cm. length caught per hour by 50 feet otter-trawl in 1903—1904 ... 33
— 10. C, D, E. No. of plaice of the I-Gr. caught per hour by 50 feet otter-trawl in 1905—1907 ... 33
— 11. No. of plaice of the II-Gr. caught per hour by 50 feet otter-trawl from 1905—1907 ... 34
— 12. No. of plaice of the III-Gr. caught per hour by 50 feet otter-trawl from 1905—1907 ... 35

550. 25/IX. 1908.